MEMOIRS OF THE HOURGLASS CRUISES

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DIATOMS

By
RICHARD P. SAUNDERS and DONALD A. GLENN

ABSTRACT

Identifications, enumerations, and surface area estimates were made from 216 unpreserved water samples collected from August 1965 through July 1966. Surface, middle, and bottom levels were sampled monthly at six stations located 3, 5, 21, 22, and 42 (two stations) nautical miles (5.6, 9.3, 38.9, 40.7, and 77.8 km) from shore in the Gulf of Mexico between St. Petersburg and Ft. Myers, Florida. The abundance levels, cellular surface areas, and species composition of diatom populations at these stations were examined from the standpoints of seasonality, sampling depths, and salinity; 186 taxa were recorded.

Stations located near shore produced the heaviest cell concentrations; those offshore the least. Diatoms (all depths combined) averaged 1.4 x $10^7 \mu^2/1$ surface area offshore, 13.6 x $10^7 \mu^2/1$ at intermediate locations, and 13.0 x $10^8 \mu^2/1$ inshore. Average cell numbers per liter were 8,570, 69,600, and 1,096,600. The average numbers of taxa recorded were 22, 31, and 42. Species with the greatest total surface area per liter of sample were: *Rhizosolenia alata, R. setigera, R. stolterfothii, Skeletonema costatum, Leptocylindrus danicus, Rhizosolenia fragilissima, Hemidiscus hardmanianus, Guinardia flaccida, Bellerochea malleus, and Cerataulina pelagica.*

INTRODUCTION

Conger (1954a), in his historical review of diatom studies of the Gulf of Mexico, stated, "the few studies made have been of somewhat casual, quite limited, and localized nature leaving almost the entire shoreline and open water areas of the Gulf completely unexplored." Freese (1952), Curl (1959), Simmons and Thomas (1962), and Wood (1963) have added substantially to our

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Effective July 1, 1969, while this paper was in press, agencies of the State of Florida underwent legislative reorganization and the Florida Board of Conservation was renamed the Florida Department of Natural Resources. Similarly, the former Division of Salt Water Fisheries became the Division of Marine Resources. These names should consequently be considered synonymous in this publication.

knowledge, but a comprehensive analysis, such as Hendey's (1964) account of the diatoms of British coastal waters, has yet to be completed.

Sampling for this study was conducted in the Gulf between St. Petersburg and Ft. Myers, Florida, well within a region known for red tides. This region has been investigated by King (1950), Davis (1950), Curl (1959), Dragovich (1963), and Saunders *et al.* (1967). Related phytoplankton productivity studies have been conducted in the Tortugas (Riley, 1938), the eastern Gulf of Mexico (Marshall, 1956), and St. Andrew Bay, Florida (Hopkins, 1966).

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METHODS AND MATERIALS

Phytoplankton sampling was restricted to three levels (surface, middepth, and bottom) at six stations located from 6 to 78 km (3 to 42 nautical miles) from shore and varying in depth from 6 to 39 m (20 to 128 ft) (Table I). A description of Hourglass stations, sampling dates and hydrographic

TABLE 1. LOCATION, DATE, AND SAMPLING DEPTH OF HOURGLASS PHYTOPLANKTON STATIONS

Station	Location	Depth	
		ft.	meters
F	*27°03′N, 83°14′W 42 naut. mi. (77.8 km) W of Venice	128	39.0
G	**26°44′N, 82°41′W 22 naut. mi. (40.7 km) W of Gasparilla Island	78	23.8
H	26°36′N, 82°16′W 3 naut. mi. (5.6 km) W of Captiva Pass	22/28	6.7
N	27°03′N, 83°14′W Same location as F	128	39.0
O	***27°19′N, 83°00′W 21 naut. mi. (38.9 km) W of Longboat Key	78	23.8
P	27°35′N, 82°51′W 5 naut. mi. (9.3 km) W of southern tip of Passage Key	20	6.1

Date of sampling:

Stations F, G, and H: 8-5-65, 9-1-65, 10-6-65, 11-9-65, 12-4-65, 1-4-66, 2-8-66, 3-5-66, 4-8-66, 5-4-66, 6-7-66, 7-4-66

Stations N, O, and P: 8-8-65, 9-5-65, 10-14-65, 11-14-65, 12-14-65, 1-14-66, 2-15-66, 3-22-66, 4-13-66, 5-12-66, 6-14-66, 7-7-66

*27°03′N, 83°18′W for August 1965
**26°43′N, 82°41′W for August 1965
***27°19′N, 83°00′W for August 1965

data are provided in Volume I, Part I of this series of publications. The location of stations and the cruise pattern of the R/V *Hernan Cortez* are shown in Figure 1.

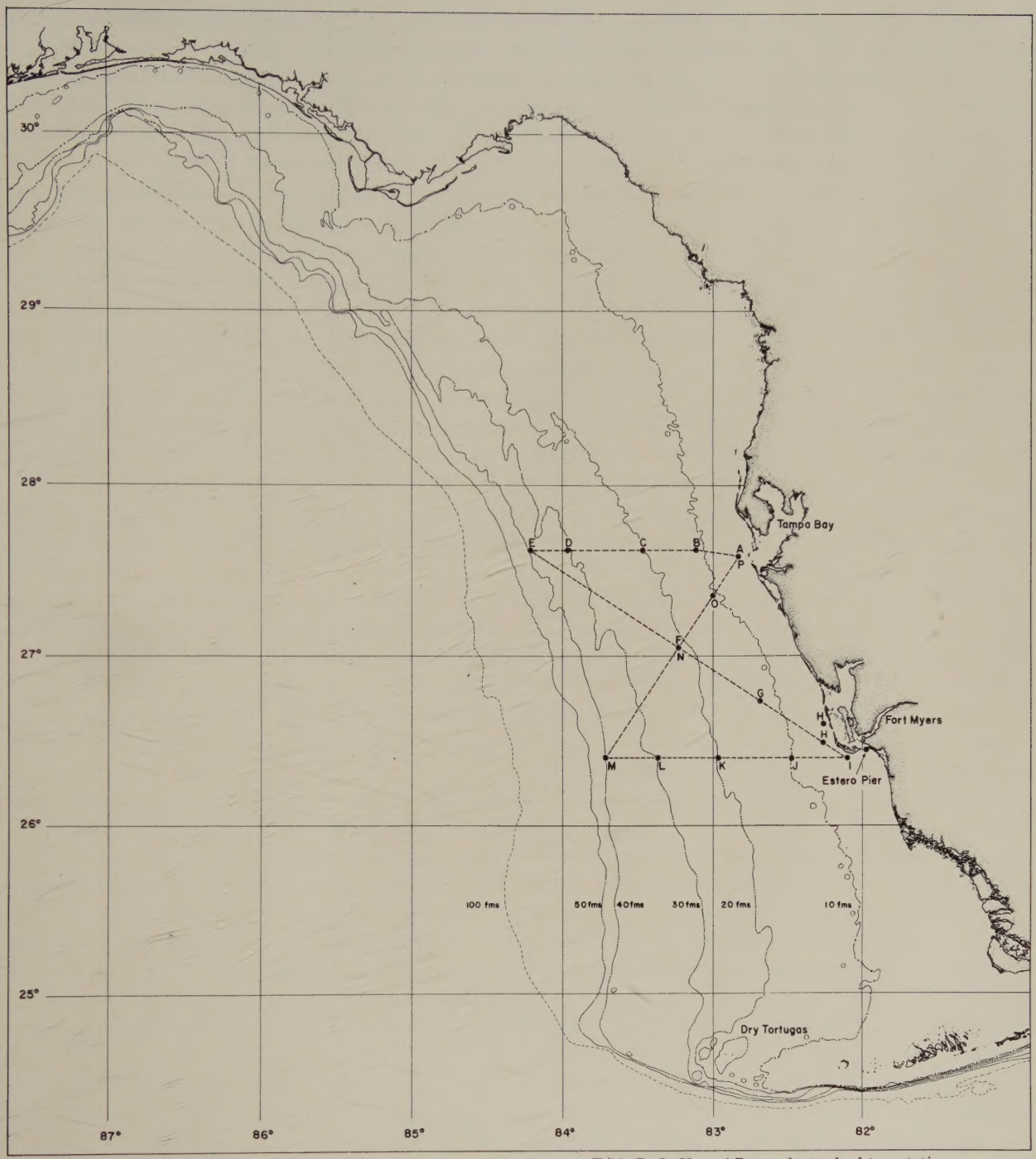


Figure 1. Hourglass cruise pattern and station locations. Stations F/N, G, O, H, and P are phytoplankton stations.

Standard hydrographic and meteorological data (as described in Volume I, Part I) were recorded for each sample. Temperatures were taken with an immersion thermometer as the samples were brought on board. Additional water samples were stored in airtight plastic containers and brought back to the laboratory for salinity titrations.

Phytoplankton samples were collected with a Van Dorn water sampler and retained in widemouthed glass jars of 946 ml capacity. These were protected from sudden temperature changes and direct sunlight. Samples from Stations F, G, and H were brought back to the Laboratory by automobile as soon as the vessel reached Ft. Myers, thus increasing the time before enumeration.

However, enumerations of all samples were always completed within 72 hours of their collection and most samples were completed within 48 hours. Prior to examination, samples were kept in a constant-temperature room at 70°F. No attempts were made to measure changes in cell number or species composition which may have occurred during the period between collection and enumeration of samples.

Sample Enumeration

Enumeration techniques were formulated to: 1) permit the identification and enumeration of as many species and forms as possible; 2) provide some means of determining accuracy of counts; 3) allow a close examination of live specimens, including cellular measurements, sketches, and photographs. Liter estimates were projected for all species encountered. Those species not identifiable were recorded to genus or as "pennate," "centric," or "naviculoid."

The wide variance in size, shape, and specific gravity of component species in samples made the process of enumeration tedious. Counts of chain-forming species, for example, were probably less precise than those for species regularly occurring as single cells. The difficulty in detecting highly transparent species probably led to their numbers being underestimated. Estimation of numbers of *Rhizosolenia* spp. was hampered by the flotation of these species at the surface of the sample containers.

Species composition and cell numbers fluctuated greatly throughout the study. Consequently, cell number estimates were determined by a flexible, largely subjective technique composed of four subsampling methods.

After gently inverting the sample jar three times, one or more 10 ml subsamples were withdrawn with a 10 ml pipette and dispensed into Syracuse watch glasses. One or two subsamples were examined if diatoms were dense (10^5 or more cells/liter) but eight or ten were necessary if diatoms were sparse (approximately 10^2 cells/liter). Initial examination of these subsamples permitted estimation of general abundance and species composition. When diatoms were scarce, specimens observed with dissecting microscopes were transferred with micropipette to slides for enumeration with phase or brightfield microscopes.

The abundance of species numbering approximately 10^6 or more cells/liter was estimated from 0.02 ml subsamples covered with No. 1 thickness 22 x 44 mm cover slips. Counts of three to five such subsamples were made for each sample by scanning the contents of entire cover slips at 100 magnifications. This technique produced consistent counts, if thorough agitation immediately preceded the drawing of the subsample by pipette.

Species within the range of 10^4 to 10^6 cells/liter were enumerated by examining 1 ml of sample dispensed on slides as drops with a graduated 1.0 ml pipette. All cells visible at 100 to 200 magnifications were counted in this manner. When identifications were first carefully verified by other techniques, this method provided a rapid and reliable estimate of abundance for certain species.

Finally, after 24 hours, a large-bore pipette was used to withdraw 10 ml of material from the bottom of the sample jar. Species which numbered fewer than 100 cells/liter or which were missed with other techniques were revealed by the examination of this residue.

Macroscopic specimens were sorted from 10 ml subsamples; smaller, more numerous species were estimated from 1.0 or 0.02 ml subsamples. Occasional smaller species, when scarce, were also enumerated from 10 ml subsamples. Although tabular data have not been rounded off, sampling errors of 10% are generally recognized.

In contrast to our previous studies, this multiple subsampling procedure noticeably increased the number of taxa recorded. The appearance of species in two or more subsample types provided a means for gauging the accuracy of counts while the examination of replicate subsamples served as a check on the efficiency of both observers. The reliability of data probably increased during this investigation, since our ability to make identifications steadily improved.

Slides and Preserved Material

Following the completion of counts, samples were filtered using 47 mm, 0.45 μ millipore filters. Samples were washed free of salt with tap water, preserved, and placed in small bottles for storage. This material provided specimens for checking or establishing identifications and obtaining additional measurements, and served as a source of diatoms for permanent slide mounts. Permanent slides were prepared from approximately 60% of all samples and bottom samples were always included. A number of species were observed only in permanent slides.

Slides were made according to the following procedure. Round, 18 mm No. 1 cover slips were placed on a slide warmer and a few drops of preserved material were added. A drop of concentrated hydrogen peroxide added during the drying process sufficed to clear the diatoms of much organic material. A small drop of "Hyrax" was placed at the desired location on a clean slide. Once a slip had dried it was removed and placed face down over the mountant. A two-hour period of gentle heating (100°C) was sufficient to harden the mountant.

Cellular Measurements

Some diatoms varied significantly in size. To take these variations into account, species from different samples were measured with 50 or 100 division ocular micrometers and their average physical dimensions determined. These measurements were converted to rough estimates of cell surface area (μ^2) by treating most species as cylinders, spheres, or rectangles. The surface areas of *Nitzschia closterium* (?), *Climacodium frauenfeldianum, and Asterionella japonica* were graphically determined.

RESULTS AND DISCUSSION

Temperature and Salinity

The temperatures of samples ranged from 14.0-31.2°C (Appendix I). Offshore stations were characterized by a narrower range of temperatures (17.5-30.0°C) than either middle (16.0-29.9°C) or inshore stations (14.0-31.2°C). The average yearly temperatures at these stations were 22.6°C, 23.0°C, and 23.5°C.

The salinity range of samples was 24.4-36.4°/oo (Appendix II). The ranges and averages were 28.8-36.4°/oo and 35.7°/oo at offshore stations, 32.2-36.2°/oo and 35.3°/oo at middle stations, and 24.4-36.0°/oo and 33.9°/oo at inshore stations.

In most months salinity increased and temperature decreased in an offshore direction. Ranges in hydrographic values tended to be narrowest offshore and broadest inshore (Table 2). Surface and bottom values differed little except during August and September. Gradients as great as 7.1°/oo and 6.7°C occurred during these months at offshore stations (Table 2).

TABLE 2. SALINITY AND TEMPERATURE RANGES AND AVERAGES OF PHYTOPLANKTON (DIATOM) STATIONS (August 1965 through July 1966)

Station		Salinity (°/oo)			Temperature (°C)		
		High	Low	Average	High	Low	Average
Surface							
	F/N	36.3	28.8	35.4	30.0	17.5	23.5
	G	36.2	32.2	35.1	29.5	19.0	23.7
	O	35.8	34.2	35.1	29.9	17.0	23.1
	H	34.8	31.2	33.8	31.2	15.5	23.9
	P	35.0	32.8	34.1	30.4	18.0	23.7
Bottom							
	F/N	36.3	30.5	35.8	27.8	17.5	21.2
	G	36.2	34.0	35.5	29.8	16.0	22.4
	O	35.9	35.2	35.5	29.3	17.0	22.7
	H	36.0	28.7	34.3	30.7	14.0	23.4
	P	35.3	27.6	33.7	30.2	17.0	23.2

The difference between the highest and lowest salinities recorded for all samples was 12.0°/oo. Approximately 96% of all samples ranged from 32.1 to 36.4°/oo and 64% were 35.1°/oo or higher. Nearly one-third of listed species in Table 3 reached their maximum frequencies at salinities from 33.1-35.0°/oo. The remaining species were more evenly distributed.

Leptocylindrus danicus, Rhizosolenia alata, Guinardia flaccida, Nitzschia pungens, and *Nitzschia closterium* (?) were frequently recorded at all salinity levels (Table 3). A majority of the species of

TABLE 3. PERCENT FREQUENCY OF MAJOR DIATOMS AT VARIOUS SALINITIES

	Number of Samples								
	2	3	3	8	24	38	102	36	216
	Salinity °/oo								
	24.1-28.0	28.1-31.0	31.1-32.0	32.1-33.0	33.1-34.0	34.1-35.0	35.1-36.0	36.1-37.0	All Samples
Taxa	Percent Frequency								
Paralia sulcata	100	67	33	12	62	18	10	17	20
Skeletonema costatum	100	0	0	75	83	82	24	0	38
Porosira sp.*	0	0	0	0	17	34	19	28	21
Cyclotella sp.	0	0	0	62	58	18	24	0	23
Thalassiosira aestivalis	50	0	67	100	17	18	1	0	11
T. decipiens	0	0	0	37	50	26	12	17	15
Coscinodiscus eccentricus	0	33	0	25	25	5	23	39	22
C. granii	0	0	0	12	29	8	4	3	7
C. concinnus	0	33	0	12	8	3	2	0	3
C. centralis	50	33	0	0	25	8	3	3	7
Hemidiscus hardmanianus	100	67	33	12	4	16	11	3	12
Biddulphia regia	0	0	67	12	17	8	2	0	6
B. alternans	0	0	0	12	42	5	1	0	6
B. aurita	0	0	0	25	21	16	2	0	7
Hemiaulus sinensis	0	0	67	50	46	37	31	39	36
H. membranaceus	0	0	0	0	4	18	19	22	16
Lithodesmium undulatum	0	0	0	25	25	13	3	6	8
Bellerochea malleus	0	33	67	37	71	37	9	3	22
Climacodium frauenfeldianum	0	0	0	0	4	45	28	14	24
Streptotheca tamesis	50	0	0	50	46	8	5	8	12
Cerataulina pelagica	0	0	0	50	37	34	25	8	31
Chaetoceros atlanticum	0	0	0	0	4	11	12	19	11
C. densum	0	0	0	0	8	8	28	28	20
C. coarctatum	50	0	0	0	4	3	10	3	6
C. glandazii	0	0	0	12	42	32	25	22	26
C. peruvianum	0	0	0	0	42	39	28	25	29
C. decipiens	0	0	0	25	33	21	33	22	28
C. lorenzianum	0	0	67	37	33	45	23	6	25
C. lauderi	0	0	0	0	29	26	19	28	21
C. compressum	0	33	67	50	67	55	32	22	39
C. didymum	0	0	33	0	37	53	21	3	24
C. constrictum	0	0	0	0	21	8	8	6	8
C. affine	0	0	33	50	17	11	6	11	11
C. costatum	0	0	0	0	12	18	6	17	10
C. pelagicum	50	0	67	25	33	53	23	8	27
C. breve	0	0	0	0	37	42	11	8	15
C. curvisetum	0	0	0	0	33	34	24	31	26
C. pseudocurvisetum	0	0	0	0	17	3	3	0	4
C. sociale	0	0	0	12	37	5	0	0	6
C. diversum	0	0	0	12	8	16	7	3	8
Chaetoceros sp. "A"	0	0	0	0	0	13	6	14	7
Bacteriastrum delicatulum	0	0	0	37	33	29	26	28	27
Bacteriastrum hyalinum	0	0	0	12	42	29	24	31	26

TABLE 3. PERCENT FREQUENCY OF MAJOR DIATOMS AT VARIOUS SALINITIES (Continued)

	Number of Samples								
	2	3	3	8	24	38	102	36	216
	Salinity °/oo								
	24.1-28.0	28.1-31.0	31.1-32.0	32.1-33.0	33.1-34.0	34.1-35.0	35.1-36.0	36.1-37.0	All Samples
Taxa	Percent Frequency								
Bacteriastrum sp. "A"	0	0	0	0	8	11	12	11	10
Leptocylindrus danicus	50	33	67	62	62	68	52	56	57
L. minimus	0	0	0	12	37	16	9	6	12
Guinardia flaccida	50	33	67	75	75	42	39	36	45
G. blavyana	0	0	0	25	8	18	7	3	9
*Schroderella delicatula**	0	0	0	0	0	5	5	11	5
Lauderia borealis	0	0	0	37	62	42	8	8	21
Corethron criophylum	0	0	33	0	17	26	15	6	15
Rhizosolenia fragilissima	100	33	67	50	29	55	18	11	27
R. bergonii	0	0	0	12	21	24	15	3	14
R. stolterfothii	0	33	67	62	75	61	52	34	53
R. robusta	0	0	0	50	37	34	25	8	25
R. imbricata	0	33	67	25	25	21	19	17	20
R. imbricata v. *shrubsolei*	0	33	33	12	42	18	23	3	20
R. setigera	100	33	67	87	75	74	45	14	50
R. calcar avis	50	33	67	50	37	42	29	17	32
R. alata	50	33	67	37	67	53	68	53	61
Rhaphoneis surirella	0	0	0	0	42	5	4	8	9
Asterionella japonica	0	33	67	50	83	37	14	0	25
Cymatosira belgica	0	0	0	0	4	5	2	14	4
Thalassiothrix mediterranea	0	0	0	12	12	8	9	0	7
Thalassionema nitzschioides	0	0	33	37	58	34	15	6	22
Navicula gigantea ?	0	0	0	0	4	13	8	3	7
N. wawrikae	50	0	0	37	25	50	29	6	28
Stauroneis membranacea	0	0	0	25	37	29	15	3	18
Pleurosigma spp.	0	33	0	37	67	39	29	22	34
Tropidoneis lepidoptera	0	0	0	50	62	16	5	0	14
Bacillaria paradoxa	50	0	0	0	37	8	4	11	10
Nitzschia pungens	50	33	67	75	67	66	45	22	49
N. closterium ?	100	33	67	12	83	58	47	42	51

*Indicates that species was not recognized early in the study.

Chaetoceros were not recorded from salinities below 32.1°/oo. Species of *Rhizosolenia* were frequently recorded at lower salinities. Diatoms found most frequently at high salinities were *Porosira* sp., *Coscinodiscus eccentricus, Chaetoceros atlanticum,* and *Cymatosira belgica.*

Diatom Abundance

Total diatoms in samples ranged from 0 to 7,809,000 cells/1 and the average was 391,600 cells/1. Yearly averages (all sampling levels combined) varied from 7,800 cells/1 at Station N to 1,209,000 cells/1 at Station P. The number of cells from inshore Stations H and P was approximately 16 times greater than from middle Stations G and O and 128 times greater than the number from offshore Stations F/N (Figure 2 and Table 4).

TABLE 4. TOTAL DIATOMS IN CELLS/LITER AT HOURGLASS PHYTOPLANKTON STATIONS, AUGUST 1965 THROUGH JULY 1966

Station	Depth	1965 August	September	October	November	December	1966 January	February	March	April	May	June	July	Average
F	S	0	25	1,200	164	1,512	17,552	32,521	5,384	4,598	187	1,000	150	5,358
	M	40	0	3,000	556	103	18,741	1,977	23,254	7,000	0	18	425	4,593
	B	146,600	830	800	587	1,474	14,690	5,852	16,357	24,205	249	1,309	3,225	18,015
N	S	0	3	2	6	6,868	112	40,807	164	2,134	449	1,534	2,070	4,512
	M	8,100	7	4	20	847	1,836	12,391	326	1,482	840	1,456	75	2,282
	B	2,060	448	63	217	3,014	1,022	5,858	1,085	1,928	184	166,825	16,950	16,638
G	S	253,800	50	250,765	7,675	22,059	2,200	3,613	3,107	220,650	2,684	67,336	669,200	125,262
	M	310,100	31	78,200	5,314	17,100	10,426	5,963	2,275	79,559	293	23,905	21,875	46,253
	B	538,340	0	19,095	1,664	11,337	17,995	19,876	582	3,597	398	328,121	4,275	78,773
O	S	929,150	16,450	1,160	4,400	20,775	21,288	14,112	6,249	25,407	30,200	426	32,800	91,868
	M	328,400	3,997	420	6,775	17,274	12,826	1,406	33,139	21,221	4,441	1,075	3,575	36,212
	B	307,350	330	360	52,500	16,095	30,422	5,766	39,016	8,731	10,155	777	300	39,317
H	S	989,900	6,500,362	253,300	8,199	270,696	60,832	7,809,202	125,932	3,645,036	13,671	957,716	1,220,700	1,821,295
	M	1,537,500	1,559,150	188,566	5,545	208,888	6,623	308,966	46,204	1,622,789	227,548	721,357	1,338,100	647,603
	B	470,650	426,600	224,850	21,293	42,240	5,010	772,651	8,228	1,976,569	518,363	149,625	1,181,000	483,090
P	S	5,237,500	34,600	1,473,676	597,029	891,028	520,960	7,016	889,415	1,307,666	403,713	1,301,500	2,361,400	1,252,125
	M	6,079,700	45,900	752,250	470,500	860,659	238,384	8,414	511,285	583,016	62,122	2,686,200	2,045,000	1,195,285
	B	5,131,250	47,466	1,009,300	8,140	8,611	221,767	435,572	285,360	498,434	62,508	5,515,625	937,800	1,180,152
Average	S	1,235,058	1,091,150	330,017	102,912	202,153	103,824	1,317,878	171,708	867,582	75,151	388,252	714,387	550,069
	M	1,377,307	274,847	170,407	81,452	184,145	48,306	56,519	102,747	385,844	49,207	572,335	568,175	322,684
	B	1,009,375	79,279	209,078	14,067	13,800	48,484	207,596	58,438	418,911	98,643	1,027,047	357,258	302,664
All depths		1,237,247	479,792	236,501	66,144	133,366	66,816	527,331	110,964	557,446	74,334	662,545	546,607	391,591

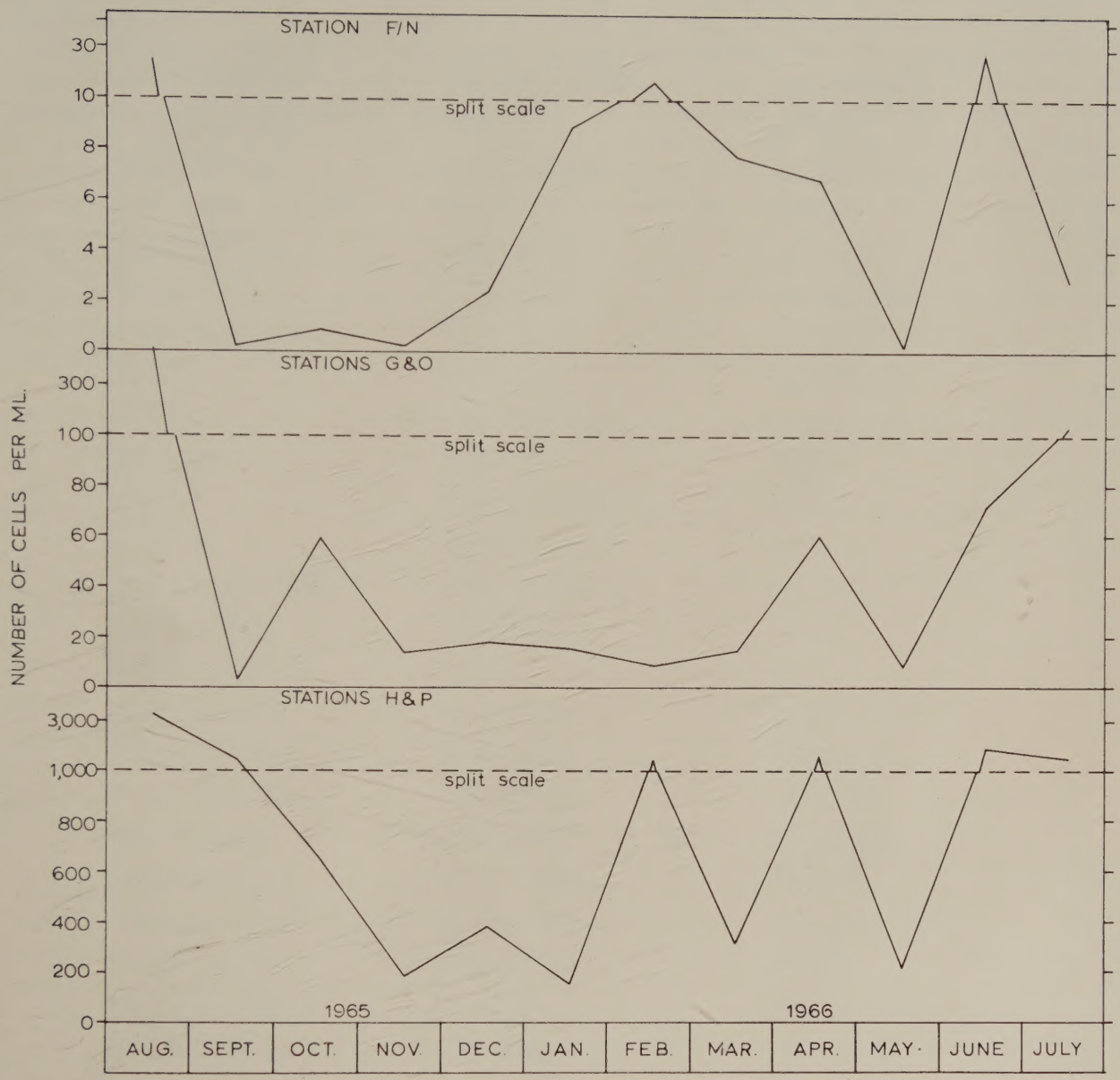


Figure 2. Seasonality of total diatom numbers at inshore stations (H and P), middle stations (G and O), and offshore stations (F/N).

Monthly fluctuation of diatom numbers was greatest at offshore stations and least at inshore locations (Figure 2), and peaks of abundance did not always coincide at the five sampling locations. In general, abundance levels were highest in June, July, and August and lowest in October, November, and May. At offshore Stations F/N there was a pronounced increase in number of species as well as in total abundance during January, February, and March.

A general decrease in diatom numbers from brackish water toward the mouths of bays was observed in our earlier study (Saunders *et al.*, 1967). Present data illustrate a continued seaward reduction in abundance to a distance of 42 miles (Stations F/N). Pratt (1959) observed the quantity of phytoplankton, of which diatoms were a major component, to decrease consistently from the upper parts of Narragansett Bay in a seaward direction.

Vertical distribution patterns of diatom populations were not clearly shown. However, heaviest concentrations appeared to occur more frequently in bottom samples offshore and in surface samples inshore.

Cellular Surface Area

The physical dimensions of diatoms vary widely, yet attempts to relate cell size to cell number are uncommon in phytoplankton literature. Riley (1957) estimated and compared the cellular volumes of diatoms and other phytoplankters in the Sargasso Sea and Hopkins (1966) determined the volumes of diatoms in St. Andrew Bay, Florida. Paasche (1960) concluded that cell surface area was a better indication of phytoplankton standing stock (shown by primary production determinations) than either cell number or cell volume. We have followed Paasche closely in analyzing the surface area composition of species in samples. Average cell numbers, cell surface area, and frequency of occurrence of major species are provided in Table 5 to indicate the relative importance of various species in the standing stock. The numbers of individuals of a species necessary to comprise a surface area in one liter of water of $10^7 \mu^2$ was arbitrarily selected as representing a bloom. Although blooms have been variously defined on the basis of increases in numbers, our method quantifies a bloom on the basis of cell surface area. The figure was chosen because it appeared to represent a rather unusual increase for any one species during the period of study.

The tremendous range in surface area of species is illustrated in Table 5. An average of 1,194 cells of the smallest species, *Chaetoceros diversum,* were needed to equal the same area comprised by one cell of the largest species, *Rhizosolenia robusta.* Twenty-eight of the 68 species listed were from 10^2 to $10^3 \mu^2$ in surface area, 26 were from 10^3 to $10^4 \mu^2$, 12 were from 10^4 to $10^5 \mu^2$, and two were greater than $10^5 \mu^2$.

The seasonal relationship of estimated total surface areas and total diatom numbers is shown in Figure 3. The ratios of these values, indicated atop the bars of the histogram, show average cell dimensions in thousands of μ^2 for the various months and stations. A considerable range in the cell surface area of average cells was found. Surface area of an average cell at Station P, for example, was 56 times greater during September 1965 than during the following June. Such variations are clearly indicative of the widespread fluctuations in species composition observed throughout the study. During the year total diatom surface area averaged $1.4 \times 10^7 \mu^2/1$ at offshore stations, $13.6 \times 10^7 \mu^2$ at middle stations, and $13.0 \times 10^8 \mu^2/1$ at inshore stations. The ratio of these surface areas (1:10:93) is similar to that previously given for diatom numbers (1:8:128).

Species Significance Based on Cell Surface Area

We have previously presented data on the seasonality of diatoms from the collective standpoints of total numbers (Figure 2 and Table 4) and total surface area (Figure 3) and have compared individual species as to their average yearly surface areas in samples (Table 5). In this section the percentage of the total diatom surface area comprised by various species is depicted on a monthly basis (Tables 6-17) to show relative importance (or dominance) of species. These data show the numbers and kinds of diatoms observed in the various months to have been highly variable.

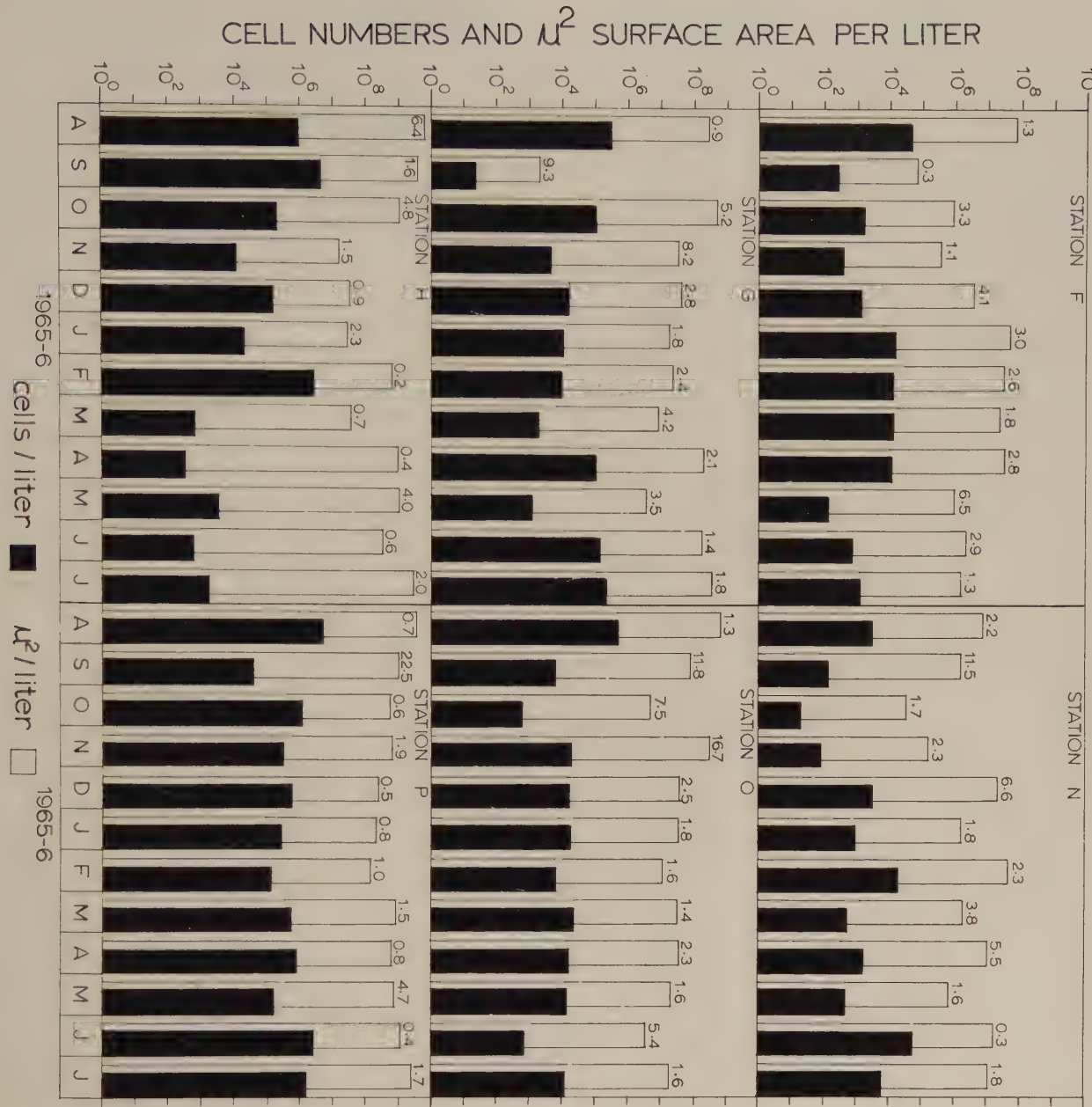

CELL NUMBERS AND μ² SURFACE AREA PER LITER
STATION F
STATION G
STATION H
STATION N
STATION O
STATION P
1965-6
cells / liter
μ² / liter
1965-6
A S O N D J F M A M J J A S O N D J F M A M J J

Figure 3. Relationship of numbers of diatoms/liter, total diatom surface area in μ^2/liter, and surface areas (in thousands of μ^2) of average cells (numbers atop bars) at sampling stations, August 1965 through July 1966.

TABLE 5. COMPARISON OF COMMONLY RECORDED SPECIES

	Diatoms	Yearly surface area $\mu^2/1$	Average number cells/1	Average cell surface (μ^2)	No. cells $=10^7\mu^2$ "bloom"	Rank avg. cell area	Rank avg. cell number
1.	*Rhizosolenia alata*	80,688,530	2,587	31,190	320	7	17
2.	*R. setigera*	43,025,612	8,374	5,138	1,946	23	9
3.	*R. stolterfothii*	36,304,554	7,293	4,978	2,008	24	11
4.	*Skeletonema costatum*	32,450,295	183,335	177	56,497	66	1
5.	*Leptocylindrus* spp.	26,946,374	22,778	1,183	8,453	41	2
6.	*Rhizosolenia fragilissima*	24,990,864	21,999	1,136	8,802	42	3
7.	*Hemidiscus hardmanianus*	21,101,864	239	88,376	113	3	45
8.	*Guinardia flaccida*	18,456,040	746	24,740	404	9	27
9.	*Bellerochea malleus*	17,589,064	2,488	7,069	1,414	17	18
10.	*Cerataulina pelagica*	17,515,440	4,505	3,888	2,572	27	16
11.	*Rhizosolenia calcar avis*	17,040,397	209	81,533	122	4	48
12.	*Nitzschia pungens*	9,440,360	19,345	488	20,490	56	4
13.	*Guinardia blavyana*	9,306,375	299	31,125	321	6	42
14.	*Chaetoceros compressum*	7,762,540	9,826	790	12,658	45	6
15.	**Rhizosolenia imbricata*	6,154,526	158	38,953	256	5	52
16.	*Lauderia borealis*	5,600,040	552	10,145	985	14	32
17.	*Pleurosigma* spp.	4,702,368	584	8,052	1,241	15	29
18.	*Asterionella japonica*	4,435,434	8,497	522	19,157	55	8
19.	*Navicula wawrikae*	4,431,195	885	5,007	1,997	23	26
20.	*Chaetoceros pelagicum*	4,211,920	13,040	323	30,959	61	5
21.	*C. didymum*	4,128,132	9,356	447	22,371	58	7
22.	*C. lorenzianum*	4,007,612	5,842	686	14,577	50	14
23.	*C. lauderi*	3,631,292	1,337	2,716	3,681	31	22
24.	*Thalassionema nitzschioides*	3,593,655	6,143	585	17,094	52	13
25.	*Hemiaulus sinensis*	2,939,504	1,717	1,712	5,841	34	21
26.	*Navicula gigantea ?*	2,883,348	156	18,483	541	11	53
27.	*Nitzschia closterium ?*	2,086,544	8,272	252	39,682	64	10
28.	*Chaetoceros affine*	1,913,616	6,984	274	36,496	63	12
29.	*Rhizosolenia robusta*	1,863,199	13	143,323	69	1	66
30.	*Chaetoceros curvisetum*	1,637,672	2,512	761	13,140	47	19
31.	*Streptotheca tamesis*	1,528,770	131	11,670	856	13	54
32.	*Rhizosolenia bergonii*	1,279,162	47	31,046	322	8	64
33.	*Bacteriastrum delicatulum*	1,204,318	1,718	701	14,265	48	20
34.	*Climacodium frauenfeldianum*	1,197,152	209	5,728	1,745	20	47
35.	*Porosira* sp.	1,190,995	65	18,323	545	12	59
36.	*Coscinodiscus eccentricus*	1,173,703	179	6,557	1,525	18	49
37.	*Thalassiothrix mediterranea*	1,044,111	327	3,193	3,131	29	40
38.	*Rhaphoneis surirella*	1,007,083	4,961	203	49,261	65	15
39.	*Corethron criophylum*	923,400	570	1,620	6,172	36	30
40.	*Tropidoneis lepidoptera*	843,392	599	1,408	7,102	37	28
41.	*Stauroneis membranacea*	834,498	179	4,662	2,145	25	50
42.	*Bacillaria paradoxa*	785,884	337	2,332	4,288	33	39
43.	*Biddulphia regia*	720,864	36	20,024	499	10	63
44.	*Chaetoceros coarctatum*	646,784	163	3,968	2,520	26	51
45.	*C. decipiens*	557,323	559	997	10,030	43	31
46.	*Lithodesmium undulatum*	557,248	88	6,321	1,582	19	57
47.	*Chaetoceros glandazii*	532,800	444	1,200	8,333	40	37
48.	*Thalassiosira decipiens*	455,169	1,061	429	23,310	59	24
49.	*Schroderella delicatula*	451,918	62	7,289	1,371	16	60
50.	*Paralia sulcata*	408,660	294	1,390	7,194	38	43
51.	*Bacteriastrum hyalinum*	380,030	305	1,246	8,025	39	41
52.	*Chaetoceros breve*	378,543	491	773	12,936	46	36
53.	*Cyclotella* sp. ?	366,450	525	698	14,326	49	34
54.	*Chaetoceros costatum*	361,836	1,311	276	36,231	62	23
55.	*C. peruvianum*	356,970	219	1,630	6,134	35	46
56.	*Hemiaulus membranaceus*	319,580	58	5,510	1,814	21	61
57.	*Chaetoceros densum*	303,660	126	2,410	4,149	32	56
58.	*Cymatosira belgica*	292,098	534	547	18,281	54	33

TABLE 5. COMPARISON OF COMMONLY RECORDED SPECIES (Continued)

Diatoms	Yearly surface area μ^2/1	Average number cells/1	Average cell surface (μ^2)	No. cells $=10^7\mu^2$ "bloom"	Rank avg. cell area	Rank avg. cell number
59. *Bacteriastrum* sp. "A"	240,864	416	579	17,271	53	38
60. *Thalassiosira aestivalis*	189,090	495	382	26,178	60	35
61. *Chaetoceros diversum*	116,160	968	120	83,333	68	25
62. *C. constrictum*	106,340	130	818	12,224	44	55
63. *Coscinodiscus concinnus*	63,452	0.5	135,005	74	2	68
64. *C. granii*	53,760	16	3,360	2,976	28	65
65. *Chaetoceros* sp. "A"	41,610	285	146	68,493	67	44
66. *Chaetoceros atlanticum*	35,112	77	456	21,929	57	58
67. *C. danicum*	33,936	56	606	16,501	51	62
68. *Coscinodiscus centralis*	21,070	7	3,010	3,322	30	67

**Rhizosolenia imbricata* and the form *shrubsolei* are grouped together.

TABLE 6. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, AUGUST 1965

Species	August					
	Stations					
	F	N	G	O	H	P
Coscinodiscus eccentricus	83.0					
Skeletonema costatum						3.8
Hemiaulus membranaceus		29.0				
Cerataulina pelagica	2.8	3.4				
Chaetoceros pelagicum			15.0	2.5		4.1
C. decipiens		3.5				
C. lorenzianum						4.8
C. lauderi				8.5		
C. compressum			20.0	39.0		9.1
C. didymum						5.0
C. affine						3.1
Bacteriastrum delicatulum		4.0	3.6			
Leptocylindrus danicus						14.0
Guinardia flaccida			30.0			
Bellerochea malleus					3.2	
Rhizosolenia alata		28.0		31.0	65.0	
R. fragilissima			8.3		3.4	3.5
R. stolterfothii			5.9	4.9	3.8	
R. robusta		13.0				
R. imbricata					3.1	
R. setigera				2.2	14.0	28.0
Pleurosigma spp.	1.6					
Nitzschia pungens	9.9		2.7	2.4		6.3
Nitzchia closterium ?	2.6					
Navicula wawrikae		6.6		3.0		4.2
Approximate total surface area (mm^2), all species encountered	66	7	332	688	6,320	4,000
Total number of taxa enumerated	12	21	25	24	29	35

TABLE 7. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, SEPTEMBER 1965

Species	September					
	Stations					
	F	N	G	O	H	P
Coscinodiscus concinnus *		84.0		3.6		
C. eccentricus		8.2				
Skeletonema costatum					7.7	
Hemidiscus hardmanianus				86.0	7.6	95.0
Chaetoceros compressum					3.5	
Hemiaulus membranaceus						0.5
H. sinensis					2.5	
Leptocylindrus danicus	86.0	6.8				
Guinardia flaccida				3.2	5.6	0.4
Rhizsolenia alata				1.2	2.6	
R. fragilissima				1.7		
R. robusta				1.7		
R. setigera					11.0	0.9
R. calcar avis					52.0	0.6
Navicula gigantea ?				1.5		
Nitzchia closterium			99.0			
Approximate total surface area (mm^2), all species encountered.	.07	2	.3	82	4,420	960
Total number of taxa enumerated	6	8	5	20	39	24

*Post auxospore stage

TABLE 8. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, OCTOBER, 1965

Species	October					
	Station					
	F	N	G	O	H	P
Paralia sulcata	4.8					
Coscinodiscus eccentricus		33.0				
Skeletonema costatum						22.0
Hemiaulus membranaceus			0.8			
H. sinensis	44.0					
Bellerochea malleus					16.0	36.0
Cerataulina pelagica		39.0			54.0	
Chaetoceros glandazii			0.5			
C. decipiens			0.5			
C. lorenzianum						1.7
C. compressum			0.7			2.6
C. curvisetum		7.6				
C. pseudocurvisetum						2.1
Bacteriastrum hyalinum		12.0		4.6		
Bacteriastrum sp. "A"	37.0		0.6			
Guinardia flaccida			91.0	6.7	2.9	1.8
Lauderia borealis					6.2	
Rhizosolenia alata				60.0	2.7	1.9
R. stolterfothii					6.6	
R. imbricata					1.4	
R. setigera					2.0	
R. calcar avis				12.0	1.3	1.8
Biddulphia regia						5.9
Thalassiothrix mediterranea						4.0
Thalassionema nitzschioides						2.2
Navicula gigantea			2.5			
N. membranacea				5.1		
Pleurosigma	6.8				3.8	1.8
Nitzschia pungens			2.1			2.7
Nitzschia closterium?			0.5			
Approximate total surface area (mm^2), all species encountered.	9	.04	602	5	1,070	609
Total number of taxa enumerated	11	12	26	11	39	53

TABLE 9. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, NOVEMBER, 1965

Species	November					
	Station					
	F	N	G	O	H	P
Coscinodiscus eccentricus	47.0					
Cyclotella sp.	6.8					
Skeletonema costatum					9.7	5.1
Hemidiscus hardmanianus					8.5	
Bellerochea malleus						13.0
Climacodium frauenfeldianum			4.7	1.2		
Chaetoceros densum				2.3		
C. coarctatum		8.5	11.0			
C. sociale						1.8
Guinardia flaccida				4.6	27.0	2.0
Lauderia borealis						2.6
Rhizosolenia alata			44.0	74.0		21.0
R. fragilissima						12.0
R. stolterfothii			9.2	2.5		12.0
R. robusta			2.8	13.0	47.0	
R. imbricata			15.0			1.8
R. setigera				0.5		16.0
R. calcar avis		87.0				
Asterionella japonica						3.1
Thalassiothrix mediterranea				0.6		
Pleurosigma spp.	39.0					
Tropidoneis lepidoptera						1.7
Nitzschia closterium ?	4.8					
Approximate total surface area (mm^2), all species encountered.	.5	.2	40	355	176	689
Total number of taxa enumerated	14	13	25	22	21	48

TABLE 10. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, DECEMBER, 1965

Species	December					
	Station					
	F	N	G	O	H	P
Paralia sulcata					2.0	
Skeletonema costatum					12.0	58.0
Hemidiscus hardmanianus					3.8	
Biddulphia alternans				1.4		
B. aurita					2.3	
Hemiaulus membranaceus		9.8				
H. sinensis				1.4		
Bellerochea malleus					54.0	1.5
Chaetoceros densum	27.0	3.1	11.0			
C. decipiens				11.0		
C. lauderi				1.4		
C. compressum				3.9		
C. constrictum				5.0		
C. curvisetum				2.6		
Leptocylindrus danicus			2.8			
Guinardia flaccida	51.0	40.0	6.1	1.2		
Rhizosolenia alata	11.0		12.0	34.0		11.0
R. stolterfothii	3.9	19.0	2.3	18.0		6.1
R. robusta		10.0				
R. imbricata		10.0	24.2			2.5
R. setigera			2.6		4.8	
R. calcar avis			8.6	15.0		1.9
Asterionella japonica						1.9
Thalassiothrix mediterranea			4.9			
Thalassionema nitzschioides					6.7	
Navicula gigantea ?					2.4	
Pleurosigma spp.		2.3	12.0		2.4	
Tropidoneis lepidoptera					2.0	2.4
Nitzschia pungens			3.2			
N. closterium ?					2.8	
Approximate total surface area (mm^2), all species enumerated.	4	23	48	44	39	294
Total number of taxa enumerated	23	27	38	35	35	49

TABLE 11. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, JANUARY 1966

Species	January					
	Station					
	F	N	G	O	H	P
Paralia sulcata		10.0				
Cyclotella sp.					5.4	
Coscinodiscus eccentricus		12.0				
Porosira sp.				25.0	3.9	16.0
Skeletonema costatum				2.3		15.0
Bellerochea malleus						5.0
Cerataulina pelagica	2.4			1.7	2.9	1.8
Chaetoceros atlanticum				1.5		
C. densum		3.1		1.7		
C. decipiens	2.3		3.1	2.0	1.2	4.3
C. lauderi			8.1	13.0		6.6
C. compressum	5.3		10.0	11.0		2.3
C. curvisetum			6.8	2.1		
Bacteriastrum delicatulum	5.1	18.0	2.2			
Leptocylindrus danicus	3.1		2.7	5.4		5.3
Guinardia flaccida	13.0	25.0	6.5	9.6		1.8
Lauderia borealis				2.6	7.6	17.0
Rhizosolenia alata	15.0		18.0			
R. stolterfothii	22.0		2.2	5.6	1.6	2.2
R. robusta	4.8					1.9
R. imbricata	14.0	7.9		2.4		1.6
R. setigera		14.0	3.2	2.2		3.3
R. calcar avis	2.7				61.0	
Navicula membranacea				5.0		
Pleurosigma spp.					0.9	
Tropidoneis lepidoptera						2.1
Nitzschia pungens					11.0	3.5
Nitzschia closterium ?					1.1	
Approximate total surface area (mm^2), all species encountered	51	2	19	39	31	262
Total number of taxa enumerated	37	34	38	44	32	54

TABLE 12. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, FEBRUARY 1966

Species	February					
	Station					
	F	N	G	O	H	P
Paralia sulcata					0.7	1.9
Cyclotella sp.					0.5	
Coscinodiscus eccentricus		1.8				
Porosira sp.	5.2			4.4		
Skeletonema costatum					86.0	15.0
Hemiaulus membranaceus	16.0					
Lithodesmium undulatum					1.3	1.7
Bellerochea malleus					0.7	19.0
Cerataulina pelagica		4.2	1.7			
Streptotheca tamesis					2.3	7.3
Climacodium frauenfeldianum	27.0					
Chaetoceros densum				2.6		
C. coarctatum		1.1		12.0		
C. decipiens	2.7	1.3	3.9	3.3		
C. lauderi	12.0	1.2				
C. curvisetum	8.7					
C. costatum		1.1				
Bacteriastrum delicatulum				3.4		
B. hyalinum		6.1				
Bacteriastrum sp. "A"	1.2					
Leptocylindrus danicus	1.2			3.6		
Guinardia flaccida	8.3	22.0	12.0	2.0		23.0
G. blavyana			3.3	2.2		6.8
Schroderella delicatula		11.0				
Lauderia borealis		1.1			3.3	4.2
Rhizosolenia alata		4.9	26.0	4.8	0.4	
R. stolterfothii		21.0	2.4	4.6		1.0
R. robusta		10.0	10.0	34.0	0.7	
R. imbricata		5.3	5.2	11.0		
R. setigera	4.2		9.5	2.0		6.6
R. calcar avis	8.2					
R. bergonii			3.3			
Asterionella japonica					1.5	
Thalassionema nitzschioides					0.5	
Navicula membranacea			4.7		0.4	
Tropidoneis lepidoptera						8.9
Nitzschia closterium ?			5.4			
Approximate total surface area (mm^2), all species encountered	35	47	23	11	694	145
Total number of taxa enumerated	35	54	47	37	47	38

TABLE 13. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, MARCH 1966

Species	March					
	Station					
	F	N	G	O	H	P
Paralia sulcata					7.2	
Coscinodiscus eccentricus					3.6	
Porosira sp.	4.0	23.0				
Skeletonema costatum					17.0	2.6
Hemiaulus sinensis			1.3			
Lithodesmium undulatum					3.1	
Bellerochea malleus					9.2	5.1
Cerataulina pelagica		24.0			2.0	2.1
Streptotheca thamensis					2.4	6.3
Climacodium frauenfeldianum			10.0	9.4		
Chaetoceros glandazii						1.5
C. lauderi				2.2		1.1
C. compressum	8.5			47.0		1.0
C. constrictum	3.9					
C. costatum	2.8					
C. breve	2.5					
Bacteriastrum delicatulum	2.4					
B. hyalinum	3.0		2.4	1.8		
Leptocylindrus danicus	6.5	16.0	2.0			38.0
Guinardia flaccida	14.0		2.6	4.6		
G. blavyana						7.3
Schroderella delicatula	3.9					
Lauderia borealis	2.6				3.1	0.9
Rhizosolenia alata	17.0	27.0	26.0	19.0	4.7	27.0
R. stolterfothii	8.2		1.4	1.9		
R. robusta			29.0	3.6		
R. imbricata	13.0				8.6	
R. setigera				1.7	8.6	0.8
R. bergonii			18.0		3.5	
Asterionella japonica						1.0
Navicula wawrikae			3.4			
Pleurosigma spp.					6.2	
Tropidoneis lepidoptera					3.3	1.1
Approximate total surface area (mm^2), all species encountered.	27	2	8	36	41	857
Total number of taxa enumerated	41	13	33	38	42	56

TABLE 14. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, APRIL 1966

Species	April					
	Station					
	F	N	G	O	H	P
Coscinodiscus eccentricus	22.0					
Porosira sp.				6.1		1.5
Skeletonema costatum			2.0	1.8	37.0	12.0
Hemiaulus sinensis						2.6
Certaulina pelagica			1.5			1.2
Climacodium frauenfeldianum			1.6	5.4	1.2	4.8
Chaetoceros densum		5.6				
C. glandazii			4.2	3.4		
C. pelagicum						1.9
C. lauderi		7.4		3.2	10.0	1.7
C. compressum				1.3	15.0	4.7
C. didymum			1.3	1.3	1.1	5.9
C. breve					1.0	1.2
C. curvisetum					1.0	2.1
Bacteriastrum delicatulum					1.2	
B. hyalinum		4.4	1.7			
Leptocylindrus danicus	6.7			4.8	1.0	7.6
Guinardia flaccida		20.0		6.3		
G. blavyana						13.0
Lauderia borealis				1.0		5.9
Rhizosolenia alata	51.0	54.0	75.0	33.0	14.0	13.0
R. fragilissima						1.9
R. stolterfothii			1.3			
R. imbricata				4.1		
R. setigera				21.0	1.4	11.0
R. bergonii			1.0		6.8	
Asterionella japonica					2.6	
Navicula wawrikae					0.9	
Tropidoneis lepidoptera						1.2
Pleurosigma spp.	6.6					
Approximate total surface area (mm^2), all species encountered	33	10	216	43	973	603
Total number of taxa enumerated	30	25	47	34	48	49

TABLE 15. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, MAY 1966

Species	May					
	Station					
	F	N	G	O	H	P
Coscinodiscus eccentricus	2.8					
Porosira spp.			15.0		0.8	
Hemiaulus sinensis	4.6	7.4				
H. membranaceus				30.0		1.8
Cerataulina pelagica			12.0			
Climacodium frauenfeldianum	7.3	22.0	20.0	10.0		
Chaetoceros densum	8.5					
C. atlanticum				2.0		
C. lorensianum				3.1		
Bacteriastrum hyalinum			5.5	2.2		
Leptocylindrus danicus		21.0	3.2		0.5	
Guinardia flaccida	76.0		2.5			6.1
G. blavyana						7.4
Lauderia borealis					18.0	1.7
Rhizosolenia alata		49.0	8.6	13.0		2.5
R. fragilissima					21.0	6.1
R. stolterfothii			2.1		53.0	37.0
R. imbricata					1.4	2.3
R. setigera				8.0	15.0	4.5
R. bergonii			6.2			3.0
R. calcar avis			20.0	2.8		22.0
Navicula membranacea				2.2	2.1	
N. wawrikae				16.0		
Nitzschia pungens				3.0		
N. closterium ?				1.9	1.0	
Approximate total surface area (mm^2), all species encountered	.9	.8	4	23	1,020	835
Total number of taxa enumerated	10	10	28	33	33	43

TABLE 16. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, JUNE 1966

Species	June					
	Station					
	F	N	G	O	H	P
Coscinodiscus eccentricus	9.4	11.0				
Thalassiosira aestivalis						0.6
Porosira sp.	14.0					
Skeletonema costatum					7.1	26.0
Hemiaulus membranaceus	16.0			9.0		
Biddulphia alternans						0.7
Lithodesmium undulatum						1.7
Bellerochea malleus		1.9				4.5
Cerataulina pelagica					13.0	
Streptotheca tamesis						0.8
Chaetoceros pelagicum					2.0	
C. lorenzianum			0.9		2.3	0.6
C. lauderi	8.9		70.0			
C. compressum	5.4		2.0			7.9
C. breve			1.3			
C. curvisetum			17.0		1.7	1.2
Leptocylindrus danicus	6.7	1.2	4.0	7.2	15.0	15.0
L. minimus						12.0
Guinardia flaccida				25.0		
G. blavyana	11.0				10.0	
Schroderella delicatula						2.0
Corethron criophylum					1.6	
Rhizosolenia alata	25.0	2.9		44.0		
R. fragilissima					4.5	
R. stolterfothii		1.1		4.0	2.4	
R. setigera					11.0	0.7
Cymatosira belgica		40.0				0.9
Rhizosolenia calcar avis					2.5	
Thalassionema nitzschioides					12.0	4.4
Navicula gigantea ?						2.5
Rhaphoneis surirella		28.0				5.2
N. membranacea					5.0	
N. wawrikae					3.3	2.8
Nitzschia pungens		4.6	1.2			6.2
N. closterium ?		9.1				1.2
Approximate total surface area (mm^2), all species encountered	2	19	199	4	388	1,210
Total number of taxa enumerated	20	27	35	17	41	50

TABLE 17. PERCENT SURFACE AREA COMPOSITION OF MAJOR DIATOM SPECIES, JULY 1966

Species	July					
	Station					
	F	N	G	O	H	P
Coscinodiscus eccentricus	29.0	57.0		1.1		
Cyclotella spp.					0.5	
Porosira sp.				3.1		
Skeletonema costatum					1.7	2.1
Hemiaulus membranaceus	16.0		1.0		0.7	
H. sinensis						1.7
Bellerochea malleus					0.6	18.0
Cerataulina pelagica			20.0		14.0	0.4
Climacodium frauenfeldianum				1.9		
Chaetoceros densum		1.8				
C. pelagicum			3.6			
C. lorenzianum				1.1		
C. peruvianum			1.3			0.4
C. compressum		1.9				
C. didymum			1.2		0.9	
C. costatum		2.0				
C. curvisetum					0.8	
Bacteriastrum sp. "A"				1.2		
Leptocylindrus danicus	19.0	2.3		62.0	3.0	0.7
L. minimus			0.8		0.9	
Guinardia flaccida					2.0	
G. blavyana	31.0		37.0			8.6
Corethron criophylum					1.1	
Rhizosolenia alata		2.2		6.6		
R. fragilissima			23.0		0.8	35.0
R. stolterfothii			0.7	2.1	27.0	14.0
R. robusta		10.0		5.8		
R. imbricata				7.8	4.4	
R. setigera			6.1		5.7	
R. bergonii				1.3		3.4
R. calcar avis		5.8	1.0	3.2	27.0	0.6
Cymatosira belgica		11.0				
Thalassiothrix mediterranea						0.5
Thalassionema nitzschioides					1.4	0.6
Navicula gigantea ?						5.1
N. wawrikae					0.7	
Pleurosigma spp.					1.6	5.8
Nitzschia pungens			1.2		3.5	1.3
N. closterium ?					0.5	
Approximate total surface area (mm^2), all species encountered	2	1	418	20	2,560	3,030
Total number of taxa enumerated	12	26	50	29	47	40

Species diversity was greatest offshore. On an average monthly basis there were 22 taxa per 14 mm^2 offshore, 31 taxa per 136 mm^2 at middle stations, and 42 taxa per 1,300 mm^2 inshore. Apparently the heavier cell densities inshore were produced by a few dominant species such as *Skeletonema costatum, Chaetoceros compressum, Leptocylindrus danicus,* and *Rhizosolenia setigera.*

Centric species comprised the bulk of diatoms in most months at most stations. *Guinardia flaccida, Skeletonema costatum, Leptocylindrus danicus, Rhizosolenia* spp., and *Chaetoceros* spp. formed a large percentage of this diatom fraction. *Hemidiscus hardmanianus,* a large centric species, was exceptionally important during September when it composed 86% of the total diatom surface area (30% of total cell count) at Station O and 95% (27% of total cell count) at Station P (Table 7). *Coscinodiscus eccentricus* dominated the collections at offshore Stations F/N from August through November 1965 and in July 1966 as a consequence of its relatively great abundance in bottom samples.

Estimates of diatom surface area and abundance were examined for possible linear relationships. Regression formulae, coefficients of correlation and levels of significance (all sampling levels combined) are given in Table 18. Statistical methods followed those of Croxton (1959). Paasche

TABLE 18. ANALYSIS OF LINEAR REGRESSION

Station	*y* Intercept	Slope	Coefficient of Correlation	Calculated *t*
F	-1,584	569	0.920	7.423
N	2,387	571	0.493	1.777
G	17,358	415	0.713	3.183
O	-16,214	640	0.837	4.809
H	647,460	224	0.391	1.357
P	-6,165	1,108	0.863	5.402

x = mm^2 surface area/1. y = numbers of cells/1
Level of significance: P(0.01) = 3.169, d. f. = 2. Number of samples per station (all depths combined) = 12.

(1960) obtained a coefficient of correlation of 0.50 (22 surface samples) for phytoplankton numbers vs. surface areas. The coefficients of correlation for Hourglass stations (12 samples) ranged from 0.391 to 0.920 and four stations were significant at P=0.01.

The low level of significance at Station H (P=0.20-0.25) as compared to Station P (P=0.001) points up the striking differences in species composition already noted at inshore locations (Tables 6-17). The dissimilarity in strength of linear relationship at the Station F/N location may reflect differences in sampling dates and times.

Species Account

Although water samples were small (one quart) and were collected monthly, a relatively large number of diatom species were recorded. We believe this list to be representative of neritic Gulf phytoplankton. A total of 186 diatom taxa were recorded. Within an assemblage of 67 genera of diatoms, 170 species, 13 generic designations, and 21 forms and varieties were encompassed. Taxa enumerated from live material numbered 125, while the remaining 61 were registered only in slides or preserved material (Table 19).

TABLE 19. SPECIES LIST
(Phylogenetically arranged after Hendy, 1964)

	Species	Highest Recorded Count/Liter	Highest Count			Per cent of Incidence in Samples
			Month	Station	Depth	
1.	*Paralia sulcata*	10,000	Feb.	H	Bottom	20
2.	*Podosira stelliger*	2,500	Apr.	P	Surface	3
3.	*Stephanopyxis palmeriana*	200	Sept.	F	Bottom	1
4.	*Skeletonema costatum*	7,770,000	Feb.	H	Surface	40
5.	*Porosira* sp.	4,050	Jan.	P	Bottom	21
6.	*Cyclotella* sp.	40,000	July	H	Middepth	23
7.	*Thalassiosira aestivalis*	20,000	June	P	Surface	12
8.	*T. decipiens*	100,000	Sept.	H	Surface	19
9.	*Coscinodiscus eccentricus*	25,000	Aug.	F	Bottom	23
10.	*C. radiatus*	350	Oct.	H	Bottom	3
11.	*C. granii*	1,600	Oct.	P	Surface	7
12.	*C. concinnus*	33	Sept.	N	Bottom	3
13.	*C. centralis*	500	Sept.	H	Middepth	7
14.	*Actinocyclus ehrenbergii*					Slides only
15.	*Hemidiscus hardmanianus*	18,000	Sept.	P	Middepth	11
16.	*Actinoptychus undulatus*	2,000	Feb.	H	Bottom	1
17.	*A. splendens*	250	Nov.	P	Bottom	2
18.	*Asteromphalus hookeri*	50	Apr.	N	Bottom	1
19.	*Eupodiscus radiatus*					Slides only
20.	*Aulacodiscus argus*					Slides only
21.	*Auliscus sculptus*					Slides only
22.	*A. pruinosus* ?					Slides only
23.	*Biddulphia tuomeyi*	200	Apr.	F	Bottom	3
24.	*B. regia*	4,000	Aug.	H	Surface	6
25.	*B. mobiliensis*	350	Jan.	P	Bottom	5
26.	*B. rhombus*	700	Feb.	P	Bottom	3
27.	*B. alternans*	12,500	June	P	Middepth	6
28.	*B. aurita*	80,000	June	P	Bottom	7
29.	*Hemiaulus sinensis*	153,300	Sept	H	Surface	36
30.	*H. membranaceus*	10,000	July	H	Bottom	17
31.	*Eucampia zoodiacus*	5,000	June	P	Surface	0.5
32.	*E. cornuta*	10,000	July	H	Bottom	3
33.	*Triceratium favus*	102	Apr.	F	Bottom	3
34.	*T. dubium*					Slides only
35.	*Lithodesmium undulatum*	7,500	June	P	Bottom	8
36.	*Bellerochea malleus*	155,000	July	P	Middepth	22
37.	*Climacodium frauenfeldianum*	12,000	Apr.	P	Bottom	24
38.	*Streptotheca tamesis*	6,000	March	P	Bottom	12
39.	*Cerataulina pelagica*	196,000	Oct.	H	Surface	31
40.	*Eunotogramma marinum*					Slides only
41.	*Chaetoceros atlanticum*	3,750	Jan.	O	Surface	12
42.	*C. densum*	10,000	Nov.	O	Bottom	20
43.	*C. eibenii*	2,500	Aug.	N	Middepth	2
44.	*C. boreale*	2,750	Feb.	F	Surface	5
45.	*C. coarctatum*	20,000	Aug.	P	Bottom	6
46.	*C. glandazii*	22,000	Mar.	P	Surface	26
47.	*C. danicum*	10,000	July	G	Surface	3
48.	*C. tetrastichon*	4	Jan.	N	Middepth	1
49.	*C. convolutum* ?	130,000	July	H	Middepth	2
50.	*C. peruvianum*	10,000	July	P	Surface	29
51.	*C. decipiens*	24,000	Jan.	P	Surface	29
52.	*C. mitra* ?	300	Dec.	F	Bottom	3
53.	*C. lorenzianum*	416,000	Aug.	P	Middepth	25
54.	*C. lauderi*	152,500	June	G	Bottom	21
55.	*C. compressum*	1,180,000	Aug.	P	Bottom	39
56.	*C. didymum*	850,000	Aug.	P	Surface	25
57.	*C. constrictum*	8,150	Jan.	P	Bottom	8
58.	*C. affine*	1,050,000	Aug.	P	Middepth	11

TABLE 19. SPECIES LIST (Continued)

Species	Highest Recorded Count/Liter	Highest Count			Per cent of Incidence In Samples
		Month	Station	Depth	
59. *C. costatum*	2,300	Apr.	P	Surface	10
60. *C. laciniosum*	50,000	Aug.	P	Surface	4
61. *C. pelagicum*	1,220,000	Aug.	P	Surface	27
62. *C. breve*	27,500	Apr.	H	Middepth	15
63. *C. messanense*					Slides only
64. *C. orientalis* ?	30,000	July	P	Middepth	0.5
65. *C. wighami*	30,000	June	P	Surface	1
66. *C. curvisetum*	110,000	June	G	Bottom	26
67. *C. pseudocurvisetum*	31,600	Oct.	P	Middepth	4
68. *C. debile*	80,000	Oct.	G	Surface	6
69. *C. anastomosans*	6,400	Feb.	N	Surface	1
70. *C. radicans*	140,000	Dec.	H	Middepth	3
71. *C. cinctum*	3,400	Feb.	N	Surface	2
72. *C. tortissimum*	3,700	March	P	Surface	5
73. *C. sociale*	128,000	Nov.	P	Bottom	6
74. *C. laeve*	36,250	July	H	Surface	6
75. *Chaetoceros* sp. "A"	17,500	Apr.	H	Surface	6
76. *Chaetoceros* spp.					
77. *Bacteriastrum delicatulum*	110,000	Aug.	P	Surface	29
78. *B. comosum*					Slides only
79. *B. hyalinum*	7,400	Feb.	N	Surface	27
80. *B. elongatum*	14,000	Aug.	O	Middepth	1
81. *B. biconcavum*	500	Jan.	O	Bottom	1
82. *Bacteriastrum* sp. "A"	40,000	July	P	Surface	10
83. *Leptocylindrus danicus*	650,000	Aug.	P	Bottom	57
84. *L. minimus*	320,000	June	P	Middepth	12
85. *Guinardia flaccida*	35,000	Oct.	G	Surface	45
86. *G. blavyana*	15,000	July	P	Surface	9
87. *Schroderella delicatula*	10,000	June	P	Bottom	5
88. *Dactyliosolen mediterraneus*	2,500	June	P	Middepth	2
89. *Lauderia borealis*	32,000	May	H	Surface	21
90. *Corethron criophylum*	30,000	July	H	Surface	15
91. *Rhizosolenia fragilissima*	1,240,000	July	P	Surface	27
92. *R. cylindrus*	100	Aug.	G	Surface	1
93. *R. bergonii*	5,000	July	P	Middepth	14
94. *R. delicatula*	1,100	Jan.	H	Surface	1
95. *R. stolterfothii*	195,000	July	F	Bottom	53
96. *R. robusta*	1,000	Nov.	O	Bottom	25
97. *R. imbricata*	7,000	Aug.	H	Bottom	20
98. *R. imbricata* v. *shrubsolei*	3,300	Nov.	P	Middepth	20
99. *R. setigera*	345,000	Aug.	P	Bottom	50
100. *R. hebitata*	200	June	G	Middepth	3
101. *R. calcar avis*	15,000	July	H	Middepth	32
102. *R. alata*	143,000	Aug.	H	Bottom	61
103. *R. acuminata*	250	Feb.	F	Surface	3
104. *R. castracanei*	Fragments, no whole cells observed				
105. *Rhaphoneis surirella*	600,000	June	P	Bottom	9
106. *R. amphiceros*					Slides only
107. *Asterionella japonica*	310,000	Sept.	H	Surface	25
108. *A. notata*	2,450	Dec.	G	Surface	2
109. *Cymatosira belgica*	57,500	June	P	Bottom	5
110. *Striatella unipunctata*	25	Feb.	N	Middepth	25
111. *Synedra* spp.	700	Sept.	H	Middepth	1
112. *Thalassiothrix mediterranea*	20,000	Sept.	H	Bottom	7
113. *T. frauenfeldii*	2,500	Apr.	H	Surface	2
114. *Thalassionema nitzchioides*	180,000	Sept.	H	Surface	22
115. *Plagiogramma* sp. ?					Slides only
116. *Licmophora abbreviata*	2,500	Apr.	P	Surface	2
117. *Licmosphenia clevei* ?	100	Apr.	P	Bottom	1

TABLE 19. SPECIES LISTED (Continued)

Species	Highest Recorded Count/Liter	Highest Count			Per cent of Incidence in Samples
		Month	Station	Depth	
118. *Climacosphenia moniligera*	200	Nov.	P	Middepth	1
119. *Grammatophora marina*					Slides only
120. *Rhabdonema adriaticum*	50	Dec.	P	Surface	0.5
121. *Achnanthes manifera*					Slides only
122. *A. longipes*					Slides only
123. *Cocconeis disculoides*					Slides only
124. *C. scutellum*					Slides only
125. *Navicula gigantea* ?	25,000	July	P	Bottom	7
126. *N. quarnerensoides*					Slides only
127. *N. wawrikae*	70,000	Aug.	P	Middepth	28
128. *N. cancellata*					Slides only
129. *N. distans*					Slides only
130. *N. praetexta*					Slides only
131. *N. carinifera*					Slides only
132. *N. lyra*					Slides only
133. *N. clavata*					Slides only
134. *N. forcipata* ?					Slides only
135. *N. hennedyii*					Slides only
136. *N. irrorata*					Slides only
137. *Stauroneis membranacea*	8,000	Oct.	P	Middepth	17
138. *Diploneis smithii*					Slides only
139. *D. bombus*					Slides only
140. *D. crabro*					Slides only
141. *D. chersonensis*					Slides only
142. *Caloneis westii*					Slides only
143. *Pinnularia ambigua*					Slides only
144. *Trachyneis aspera*					Slides only
145. *Mastogloia rostrata*					Slides only
146. *Mastogloia* spp.					Slides only
147. *Pleurosigma* spp. (all species)	60,000	July	P	Bottom	34
148. *P. rostratum*					Slides only
149. *P. naviculaceum*					Slides only
150. *P. reticulatum*					Slides only
151. *P. angulatum*					Slides only
152. *P. formosum*					Slides only
153. *P. strigosum*					Slides only
154. *P. reversum* ?	1	Feb.	N	Bottom	2
155. *Gyrosigma balticum*	100	Apr.	P	Bottom	2
156. *G. tenuissimum*					Slides only
157. *Gyrosigma* sp.					Slides only
158. *Amphiprora gigantea*	2,500	Apr.	H	Bottom	1
159. *Amphiprora* spp. ?	7,100	Dec.	P	Surface	2
160. *Amphiprora* sp.	1,075	June	F	Bottom	2
161. *Tropidoneis lepidoptera*	23,600	Feb.	F	Bottom	14
162. *Auricula complexa* ?					Slides only
163. *Thalassiophysa rhipidis*	1	June	N	Bottom	0.5
164. *Amphora marina*					Slides only
165. *A. ocellata*					Slides only
166. *A. arenaria*					Slides only
167. *A. alata*					Slides only
168. *A. granulata*					Slides only
169. *A. spectabilis*					Slides only
170. *A. obtusa*					Slides only
171. *A. arcus* ?					Slides only
172. *A. bigibba*					Slides only
173. *A. decussata*	14,000	May	H	Bottom	0.5
174. *Bacillaria paradoxa*	30,000	Oct.	P	Bottom	10
175. *Nitzschia panduriformis*					Slides only
176. *N. constricta*					Slides only

TABLE 19. SPECIES LIST (Continued)

Species	Highest Recorded Count/Liter	Highest Count			Per Cent of Incidence in Samples
		Month	Station	Depth	
177. *N. sigma?*					Slides only
178. *N. insignis*					Slides only
179. *N. pungens*	750,000	Aug.	P	Surface	49
180. *N. longissima*	30	Sept.	O	Bottom	1
181. *N. closterium*	500,000	Aug.	P	Surface	51
182. *Surirella gemma*					Slides only
183. *S. fastuosa*					Slides only
184. *Campylodiscus samoensis*					Slides only
185. *Campylodiscus* sp.					Slides only
186. *Naviculoid* spp.					

Information, concerning size, seasonality, and abundance of the 75 most important diatom taxa is presented in synoptic tables under the appropriate headings. Permanent slide data are provided only for those taxa not recorded in the living state. The tables indicate levels of abundance and relative importance at various stations during all months. The indication of bloom numbers by an asterisk illustrates the relative seasonal importance of various species. *Rhizosolenia fragilissima, Hemidiscus hardmanianus, Ceratualina pelagica, Nitzschia pungens, Chaetoceros pelagicum,* and *Chaetoceros lorenzianum* were in bloom concentrations during summer months, while *Rhizosolenia imbricata, Lauderia borealis,* and *Chaetoceros lauderi* were most important in winter. Blooms of *Rhizosolenia setigera, Skeletonema costatum, Bellerochea malleus,* and *Asterionella japonica* were almost exclusively restricted to inshore stations. Only a few species such as *Rhizosolenia stolterfothii, R. alata,* and *R. imbricata* bloomed at offshore stations and then only on occasion. More species were observed to reach bloom concentrations at inshore stations, especially during midwinter, than at other stations.

Our phylogenetic species arrangement is based on Hendey (1964).

DISCUSSION

The majority of marine diatoms are of two types: pelagic and benthic. The present study deals primarily with pelagic species; however, benthic species were sufficiently common to warrant their treatment and data were compiled to demonstrate interrelationships of populations. Benthic diatoms of sublittoral Gulf waters have received practically no attention and should be considered as a subject for future study.

In spite of the inherent dangers of comparing data from studies differing in geography, hydrography, sampling techniques, and analyses, certain studies may be cited to illustrate in a very general way the magnitude of correspondence of these data with our own. A few studies of comparable duration to our own are presented in Table 20.

TABLE 20. DIATOM ABUNDANCE AT HOURGLASS STATIONS COMPARED WITH ABUNDANCE DETERMINED IN OTHER STUDIES

Principal locality, authority and months of continuous sampling	No. of Stations	No. of Samples	Abundance (10^6 cells/1)	Months of Extreme Counts Low	High
Boca Grande, Fla. (King, 1950)					
May-October	8	50	0.062*	July	May
North central Sargasso Sea (Riley, 1957)					
February-January (2 yrs)	1	480 ?	0.001-.003**	Autumn	April
Continental shelf off New York (Hulburt, 1963)					
April-September	18	69	0.021**		
November-March	18	52	0.164**		
St. Andrew Bay, Fla. (Hopkins, 1966)					
July-June	11	132	0.802	November	August
St. Petersburg to Marco, Fla. Saunders *et al.*, 1967					
January-October	20	949	10.340	July	February
Hourglass Cruises					
August-July	6	216	0.009 (F/N) 0.070 (G & O) 1.106 (H & P) 0.392 (all stations)	November	August

*Counts included all plankton organisms.
**Counts consisted of phytoplankton; diatoms were the dominant organisms.

The phytoplankton populations of offshore stations showed a considerable affinity to typical subtropical or temperate oceanic situations as shown by the occurrence of such species as *Rhizosolenia robusta, Chaetoceros coarctatum,* and *C. atlanticum.* Inshore locations, on the other hand, were primarily estuarine in abundance patterns and species composition. Populations at middle stations were intermediate between offshore and inshore locations.

Most species encountered in this study are known from the Gulf (Freese, 1952; Curl, 1959; Balech, 1967). Although our reporting of rare or previously unrecorded species such as *Guinardia blavyana, Biddulphia regia, Navicula wawrikae,* and *Porosira* sp. might suggest that diatom complexes are distinct in this area, it may also reflect the refinements of our techniques.

The richest concentrations of diatoms known from the Gulf (Saunders *et al.,* 1967) occur inshore of the Hourglass phytoplankton stations. The number of diatoms from inshore Hourglass stations was approximately one order of magnitude less than previously obtained. Consequently, we regard the abundance levels of inshore stations to be strongly influenced by the proximity of estuaries.

The pattern at offshore stations was similar to that characterized by Riley (1957) for the north central Sargasso Sea. In both studies species coincidence was close and abundance levels were highly variable, ranging from 0 to approximately 10^5 cells/1. The yearly average of diatoms at Stations F/N (8,570 cells/1) was slightly greater than recorded by Riley.

The levels of abundance at Stations G and O (middle stations) were similar to those recorded by Hulburt (1963) from the continental shelf off New York. At least one infrequently reported species, *Chaetoceros glandazii,* was present at both areas. The phytoplankton, which consisted mainly of diatoms, averaged 20,700 cells/1 from April through September and 164,200 cells/1 from November through March. Our counts from Stations G and O for the same months were 118,000 and 13,800 cells/1.

Hopkins (1966), in determining the diatom volume from St. Andrew Bay samples, discovered

that "diatom volume increased with increasing salinity whereas diatom numbers were greatest at intermediate stations", implying that diatom cell size was largest at low and high salinities. We observed average diatom surface areas to increase in an offshore direction (increasing salinities and declining cell numbers). The number of diatoms per mm^2 was 914 cells at inshore stations, 622 cells at middle stations and 503 at offshore stations. These differences reflected the presence of inordinately large numbers of *Skeletonema costatum* and other smaller diatoms at inshore stations.

A midwinter maximum of numbers and surface area at offshore stations was noteworthy. No such peak occurred at other stations. Simmons and Thomas (1962) referred to findings of Freese (1952) concerning *Thalassiothrix frauenfeldii* and *Rhizosolenia alata* to suggest that a progressive inshore movement of certain species may succeed midwinter offshore blooms. *Hemidiscus hardmanianus* showed a similar pattern in our study since it was found mainly offshore in bottom samples during winter prior to its appearance and subsequent massive proliferation inshore during summer. To our knowledge blooms of this species have occurred inshore of the general area of this study during at least three successive years in late August and early September.

SUMMARY

Monthly sampling of diatoms at surface, middepth, and bottom levels was conducted from August 1965 through July 1966 at six stations in the southeastern Gulf of Mexico. These stations were located from 3 to 42 nautical miles offshore (between St. Petersburg and Ft. Myers) and ranged in depth from 20 to 128 feet. Temperature and salinity ranged from 14.0-31.2°C and from 27.6-36.4°/oo.

Enumeration of diatoms was completed for 216 one-quart unpreserved water samples. A variety of subsampling techniques were devised to secure count data for as many species as possible. Identification of species not registered in live counts was based on frustules found in permanent slides of millipore-filtered sample residues.

Cellular measurements of commonly encountered species were obtained from live and preserved material. The approximate average yearly surface area in μ^2 of enumerated species was determined and these averages were used to indicate relative importance of species in the standing stock. The approximate number of cells of a particular species required to comprise in one liter of water a surface area of $10^7\mu^2$ was defined as a bloom concentration.

A progressive decrease in diatom numbers and total cell surface area occurred from inshore stations seaward to the offshore stations. Considerable monthly variation occurred. Yearly cellular surface area was $13.0 \times 10^8\mu^2/1$ at inshore stations, $13.6 \times 10^7\mu^2/1$ at middle stations and $1.4 \times 10^7\mu^2/1$ at offshore stations.

The ten most important species of diatoms from the standpoint of their cellular surface area in the standing stock in order of importance were: *Rhizosolenia alata, R. setigera, R. stolterfothii, Skeletonema costatum, Leptocylindrus* spp., *Rhizosolenia fragilissima, Hemidiscus hardmanianus, Guinardia flaccida, Bellerochea malleus,* and *Cerataulina pelagica.* A total of 186 taxa were recorded.

SPECIES ACCOUNT

Suborder: Coscinodiscineae

Family: COSCINODISCACEAE

Paralia Heiberg

Paralia sulcata (Ehrenberg) Cleve [Pl. 6, Fig. 26]

Hustedt, Pt. I, p. 276-278, Fig. 118-9, 1927-30

Hendey, p. 73, Pl. XXIII, Fig. 5, 1964

Recorded throughout the year, most common at inshore stations and in bottom samples. This species enjoyed a widespread distribution in areas of moderate to high salinities.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F			b						d			b
N		b				c	c		b		a	
G			c		c		c					
O						a	c					b
H	D c				d		D	d d d	a	c	b	c
P	c	c c c	D d	c d	c d	a c	d	c d	a	a	c	c
Avg/1	639	41	636	96	228	45	920	728	80	39	24	51

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

7,194 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 11% Middle stations (G-O) 8% Inshore stations (H-P) 42%

Surface samples 8% Middepth samples 14% Bottom samples 39%

Measurements:

No. cells measured 5 Average surface area (square microns) per cell 1,390

Range in length 8-20μ Average length 12.4μ

Range in diameter 16-48μ Average diameter 35.7μ

Podosira Ehrenberg

Podosira stelliger (Bailey) Mann [Pl. 9, Fig. 43; Pl. 14, Fig. 106]

Hendey, p. 90, Pl. XXII, Fig. 6, 1964

Infrequent; present in seven samples during November, March, April, and July; diameter 48 μ; species probably more widespread in samples than the data indicate as it appeared commonly in permanent slides.

Stephanopyxis Ehrenberg

Stephanopyxis palmeriana (Greville) Grunow

Hustedt, Pt. 1, p. 308-9, Fig. 147, 1927-30

Recorded from three samples (September, October, and December); abundance 7 to 200 cells/liter. Curl (1959) stated that it was most common 100 miles offshore of the west coast of Florida.

Skeletonema Greville

Skeletonema costatum (Greville) Cleve

Hendey, p. 91-2, Pl. VII, Fig. 3, 1964

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F									c			
N												
G				c			c	c	E e c			d c
O				d d		d d d	e		d d d			c c
H		G F F	d e d	d d e	e E d	d	G F F	F e d	G G G		F F e	F F F
P	F G F	d d d	G F F	F F F	F F G	F F F	d d F	F F e	F F F	e d	F G G	F F F
Avg/1	145,000	322,620	128,396	35,023	165,774	37,539	503,178	28,701	409,832	1,078	319,528	100,035

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

56,497= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 26% Inshore stations (H-P) 87%

Surface samples 43% Middepth samples 37% Bottom samples 36%

Measurements:

No. cells measured 56 Average surface area (square microns) per cell 177

Range in length 3-27μ Average length 9.7μ

Range in diameter 3-12μ Average diameter 5.8μ

Frequent (87% of inshore samples) and abundant at inshore stations; considerably less important at middle stations and rare offshore; occurred in bloom concentration 44 times; auxospores present during November and December at inshore locations.

Porosira Jorgensen

**Porosira* sp. [Pl. 16, Fig. 116]

Planktonic, occurring as solitary cells or in the state of division; cells lens- to barrel-shaped; valves biconvex; valve circular and slightly concave at its center; cells large, from 14 to 115 μ in diameter; valve mantle separated from girdle by a distinct row of pores; valves appear slightly rugose at 970x phase, no other structures discernible; chromatophores numerous, associated with a central thread of protoplasm (as in *Guinardia*); cell walls delicate, collapsing when dried.

This species was not enumerated prior to January, 1966; thereafter it was both frequent and abundant in samples; more frequently observed at middle stations (28% of samples) than at either inshore (18%) or offshore stations (18%).

*Our tentative identification of this diatom as a new species of *Porosira* was confirmed by N. Ingram Hendey. A formal description of this species is anticipated in the near future.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F							c b	b b b	a		b	
N						a	a b	b b	b			
G								a	b b b	b b b	a	b
O						C C	b b	a	c c	b	a	b b
H						c			b	C c		
P						D D		a a	B C C			c b
Avg/1	0	0	0	0	0	492	24	14	119	96	3	35

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

545 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 18% Middle stations (G-O) 28% Inshore stations (H-P) 18%

Surface samples 21% Middepth samples 22% Bottom samples 21%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 18,323

Range in length 14-115μ Average length 61.3μ

Range in diameter 36-110μ Average diameter 95.2μ

Cyclotella Kützing

Cyclotella sp. ? [Pl. 6, Fig. 26; Pl. 16, Fig. 117]

Planktonic, occurring as short chains of two to five cells bound together by two or three threads; distance between cells more than twice cell height; cells short, cylindrical to barrel-shaped; cells with undulate valve faces; valves composed of an outer ring of costae and a central hyaline area with two or three pores; cell height from 7 to 15 μ diameter 11 to 34 μ; most abundant in salinities from 32.0 to 34.0°/oo.

Previously identified as *Coscinosira polychorda* Gran (Saunders and Wahlquist, 1966; Saunders *et al.*, 1967) but probably a new species of *Cyclotella;* most frequent from November through January; highest numbers noted during September and July (Station H); most frequent (61%) at salinities of 32.4 to 34.4°/oo.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F				c a								
N	c			a a	c a	a						b
G			c	b b	c	c	c	b				
O					a c	c a						
H		E e c		c	a b	d d	d d	d c b		c	b	c E d
P			c	c c	c c	d c	c c	c		b	d	
Avg/1	43	1,489	185	91	84	500	811	119	0	39	283	2,822

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

14,326 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 11% Middle stations (G-O) 17% Inshore stations (H-P) 42%

Surface samples 19% Middepth samples 21% Bottom samples 29%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 698

Range in length 7-15μ Average length 10.9μ

Range in diameter 11-34μ Average diameter 20.4μ

Thalassiosira Cleve

Thalassiosira aestivalis Gran and Angst [Pl. 6, Fig. 29]

Cupp, p. 47, Fig. 9, 1943

Species not frequent nor especially abundant; present mainly in inshore samples and at salinities below 34.4°/oo; this species appears to be identical with *Thalassiosira* sp. recorded by Saunders *et al.* (1967).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F												b
N												b
G		d c		c					b			
O												
H	c c						c				d e	
P		c b d	c	b		a a c		d d a			e e e	
Avg/1	39	730	11	31	0	23	39	889	1	0	4,167	8

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

26,178 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 7% Inshore stations (H-P) 26%

Surface samples 10% Middepth samples 12% Bottom samples 12%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 382

Range in length 5-7μ Average length 6.3μ

Range in diameter 9-32μ Average diameter 19.0μ

Thalassiosira decipiens (Grunow) Jorgensen

Hustedt, Pt. I, p. 322-3, Fig. 158, 1927-30

Species most frequent during February and March; blooms occurred at Station H during September and June, generally at salinities of 32.4 to 34.3°/oo; smaller specimens of this species are easily confused with *T. aestivalis*.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	1965 Aug. M	1965 Aug. B	1965 Sept. S	1965 Sept. M	1965 Sept. B	1965 Oct. S	1965 Oct. M	1965 Oct. B	1965 Nov. S	1965 Nov. M	1965 Nov. B	1965 Dec. S	1965 Dec. M	1965 Dec. B	1966 Jan. S	1966 Jan. M	1966 Jan. B	1966 Feb. S	1966 Feb. M	1966 Feb. B	1966 Mar. S	1966 Mar. M	1966 Mar. B	1966 Apr. S	1966 Apr. M	1966 Apr. B	1966 May S	1966 May M	1966 May B	1966 June S	1966 June M	1966 June B	1966 July S	1966 July M	1966 July B
F																						c	a												
N								a			a					a			b	c														b
G																																	d	
O																				b		a	b											
H				E	d	e	b	c									c	c	b	d	d	d	d	c		d		e		c	d	E	c		
P							d	c	c	c		c									c	d		b				d				b	e	b		

Avg/1 0 7,056 477 33 0 67 282 326 417 944 2,593 564

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

23,310 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 11% Middle stations (G-O) 6% Inshore stations (H-P) 42%

Surface samples 17% Middepth samples 15% Bottom samples 26%

Measurements:

No. cells measured 15 Average surface area (square microns) per cell 429

Range in length 5μ Average length 5μ

Range in diameter 8-45μ Average diameter 27.3μ

Coscinodiscus Ehrenberg

Coscinodiscus eccentricus Ehrenberg [Pl. 14, Fig. 100]

Hustedt, Pt. 1, p. 388-91, Fig. 201-2, 1927-30

Hendey, p. 80-1, Pl. XXIV, Fig. 7, 1964

Both *C. eccentricus* and the variety *fasciculata* Hustedt were observed but the latter was by far the most numerous and frequent in samples; this species as frequent offshore as inshore; occurred in approximately 23% of all samples.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	1965 Aug. M	1965 Aug. B	1965 Sept. S	1965 Sept. M	1965 Sept. B	1965 Oct. S	1965 Oct. M	1965 Oct. B	1965 Nov. S	1965 Nov. M	1965 Nov. B	1965 Dec. S	1965 Dec. M	1965 Dec. B	1966 Jan. S	1966 Jan. M	1966 Jan. B	1966 Feb. S	1966 Feb. M	1966 Feb. B	1966 Mar. S	1966 Mar. M	1966 Mar. B	1966 Apr. S	1966 Apr. M	1966 Apr. B	1966 May S	1966 May M	1966 May B	1966 June S	1966 June M	1966 June B	1966 July S	1966 July M	1966 July B
F		E		b			a			b										a					D			b			b		c
N		b									a					b			c					a			a		c	c		D
G		b											b		c		b		b	b					b			a			a		b
O								b			c						c											a			b		b
H		b																	a	c		b	c	c	a		a		a					
P										b									b	b										D	c			

Avg/1 1,393 4 1 22 17 22 48 41 192 1 206 186

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,525 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 25% Middle stations (G-O) 22% Inshore stations (H-P) 22%

Surface samples 6% Middepth samples 14% Bottom samples 50%

Measurements:

No. cells measured 25 Average surface area (square microns) per cell 6,557

Range in length 19-53μ Average length 36.9μ

Range in diameter 24-109μ Average diameter 56.6μ

Coscinodiscus radiatus Ehrenberg [Pl. 11, Fig. 70; Pl. 14, Fig. 98]

Hustedt, Pt. 1, p. 420-1, Fig. 225, 1927-30

Infrequent, never abundant; recorded from inshore stations (six samples) during August, October, January, and February.

Coscinodiscus concinnus Wm. Smith

Holmes and Reimann, p. 233-244, Fig. 1-13, 1966

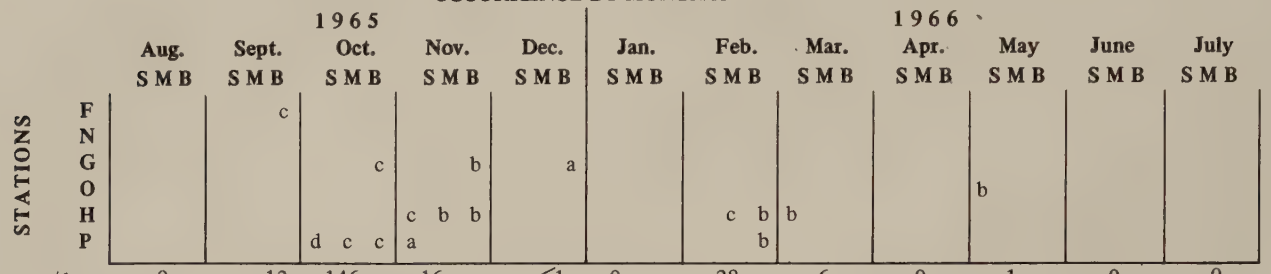
Holmes and Reimann (1966) have determined *C. granii* Gough and *C. concinnus* Wm. Smith to be the "intermediate" and the "post-auxospore" phases of a single species and have retained the name *C. concinnus* because of its priority. Both life phases are listed below and their seasonal distribution and abundance depicted graphically. The "granii" phase was slightly more abundant and frequent than was the "concinnus" phase. The two occurred together in three samples. A third life phase, described by Holmes and Reimann, was not encountered.

"Intermediate phase" (formerly *Coscinodiscus granii* Gough) [Pl. 9, Fig. 45]

Hustedt, Pt. 1, p. 436-8, Fig. 237-8, 1930

Recorded from 7% of samples; rarely recorded in summer months.

OCCURRENCE BY MONTH AND DEPTH



Avg/1	0	13	146	16	<1	0	28	6	0	1	0	0

$a=10^0$-10^1, $b=10^1$-10^2, $c=10^2$-10^3, $d=10^3$-10^4, $e=10^4$-10^5, $f=10^5$-10^6, $g=10^6$-10^7 cells / liter.

Capital letters indicate bloom concentrations.

2,976 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 6% Inshore stations (H-P) 15%

Surface samples 7% Middepth samples 4% Bottom samples 11%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 3,360

Range in length 15 μ Average length 15 μ

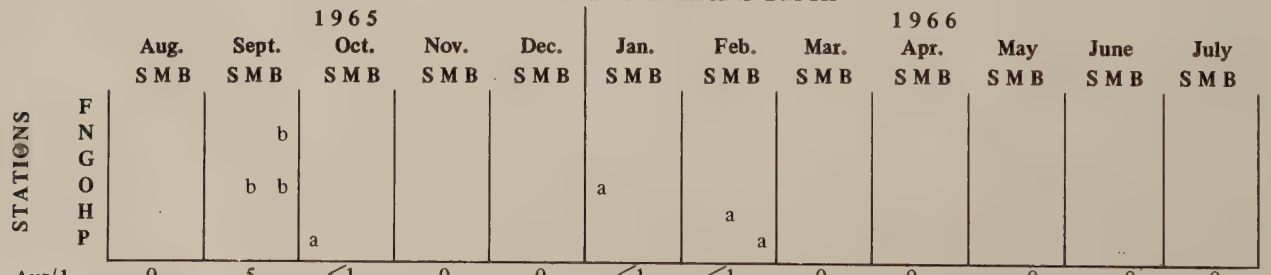
Range in diameter 46-110 μ Average diameter 71.4 μ

"Post-auxospore phase" (formerly *Coscinodiscus concinnus* Wm. Smith)

Hustedt, Pt. 1, p. 441-4, Fig. 241-2, 1927-30

Infrequent (3% of samples); not abundant; recorded only in September, October, January, and February.

OCCURRENCE BY MONTH AND DEPTH



Avg/1	0	5	<1	0	0	<1	<1	0	0	0	0	0

$a=10^0$-10^1, $b=10^1$-10^2, $c=10^2$-10^3, $d=10^3$-10^4, $e=10^4$-10^5, $f=10^5$-10^6, $g=10^6$-10^7 cells / liter.

Capital letters indicate bloom concentrations.

74 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 4% Inshore stations (H-P) 4%

Surface samples 3% Middepth samples 3% Bottom samples 4%

Measurements:

No. cells measured 2 Average surface area (square microns) per cell 135,005

Range in length 155 μ Average length 155 μ

Range in diameter 255-300 μ Average diameter 277.5 μ

Coscinodiscus centralis Ehrenberg [Pl. 9, Fig. 44]
Hustedt, Pt. 1, p. 444-5, Fig. 243, 1927-30

Almost completely restricted to inshore stations; in concentrations less than 1,000 cell/liter.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F				b												b																				
N																																				
G																																				
O																																				
H			b		c			c							b	b	a	a		c		a		b												
P					b						b				b																					
Avg/1		3			32			8			6			6			8			11			6			0			0			0			0	

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

3,322 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 0% Inshore stations (H-P) 18%

Surface samples 4% Middepth samples 10% Bottom samples 7%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 3,010

Range in length 20 μ Average length 20.0 μ

Range in diameter 65-120 μ Average diameter 95.9 μ

Actinocyclus Ehrenberg
Actinocyclus ehrenbergii Ralfs [Pl. 9, Fig. 51]
Hustedt, Pt. 1, p. 525-533, Fig. 298-302, 1927-30

Common in permanent slides from bottom samples but not registered in counts of live material.

Family: HEMIDISCACEAE
Hemidiscus Wallich
Hemidiscus hardmanianus (Greville) Mann
Curl, p. 287, Fig. 17, 1959

Relatively uncommon except during September, when it was a dominant species at Stations O, H, and P. We observed hyphae and spores of an apparent fungal parasite within cells of *Hemidiscus* at Station P during September. Dr. Christopher Martin of the Kresge Center for Environmental Health, Harvard University, identified the organism as a lagenidioid species.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																						a														
N				a		a							a			a																				
G															a																					
O				C	D	b							a			a				a																
H			C	D	D	D	b			b					b																					
P	C	C		D	E	D	b																													
Avg/1		72			2,774			11			3			3			<1			<1			<1			0			0			0			0	

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

113 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 10% Inshore stations (H-P) 18%

Surface samples 15% Middepth samples 8% Bottom samples 11%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 88,376

Range in length _____ Average length _____

Range in diameter 195-465 μ Average diameter 335.5 μ

Family: ACTINODISCACEAE

Actinoptychus Ehrenberg

Actinoptychus undulatus (Bailey) Ralfs [Pl. 9, Fig. 49]

Hustedt, Pt. 1, p. 475-8, Fig. 263-4, 1927-30

Recorded from five bottom samples (July, August, February, and March); frustules of this species were common in permanent slides.

Actinoptychus splendens (Shadbolt) Ralfs [Pl. 9, Fig. 50]

Observed in five samples from November through February.

Asteromphalus Ehrenberg

Asteromphalus hookeri Ehrenberg [Pl. 10, Fig. 53]

Hendey, p. 96, 1964

Lebour, p. 52-3, Fig. 28b, 1930

Recorded during April (Station N, bottom) and May (Station O, surface); 50 cells/liter were present in both samples; length of valves from 33 to 50 μ, breadth from 26 to 48 μ.

Suborder: Aulacodiscineae

Family: EUPODISCACEAE

Eupodiscus Rattray

Eupodiscus radiatus Bailey [Pl. 9, Fig. 48]

Hendey, p. 97, Pl. XXIII, Fig. 3, 1964

Uncommon, observed only in permanent slides.

Aulacodiscus Ehrenberg

Aulacodiscus argus (Ehrenberg) A. Schmidt, [Pl. 9, Fig. 47]

Hustedt, Pt. 1, p. 503, Fig. 281, 1927-30

Hendey, p. 97, 1964

Uncommon in the study area; observed only in permanent slides.

Suborder: Auliscineae

Family: AULISCACEAE

Auliscus Ehrenberg

Auliscus sculptus (Wm. Smith) Ralf [Pl. 11, Fig. 68]

Hendey, p. 98-9, Pl. XXIII, Fig. 4, 1964

Recorded only from a permanent slide of a Station O bottom sample (May): cell diameter 43 μ.

Auliscus pruinosus ? Bailey

Hustedt, Pt. 1, p. 511-12, Fig. 286, 1927-30

Observed in May in permanent slide (Station H, bottom); diameter 49 μ.

Suborder: Biddulphineae

Family: BIDDULPHIACEAE

Biddulphia Gray

Biddulphia tuomeyi (Bailey) Roper

Hustedt, Pt. 1, p. 834-6, Fig. 491, 1927-30

Live specimens were present in bottom samples at Stations N (February), H (March), P (February), F (April), G (May) and from middepth at Station N (February); cell length 48 to 75 μ, diameter 57 to 218 μ.

Biddulphia regia (Schultze) Ostenfeld

Hustedt, Pt. 1, p. 838-40, Fig. 494, 1927-30

Glenn, Fig. 1 and 2, 1966

Present inshore during August, September, October, December, and July; first reported from the Gulf by Glenn (1966); *B. sinensis* Greville, a related species, not encountered during the Hourglass study but recorded from Apalachee Bay (Saunders and Wahlquist, 1966).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																																				
N																																				
G																																				
O																																				
H	D	b		b	b		b	b						b																				c	c	
P							c	B	d																											
Avg/1	228			9			149			0			3			0			0			0			0			0			0			39		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

499 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 0% Middle stations (G-O) 0% Inshore stations (H-P) 17%

Surface samples 7% Middepth samples 7% Bottom samples 3%

Measurements:

No. cells measured 2 Average surface area (square microns) per cell 20,024

Range in length 159-248 μ Average length 203.5 μ

Range in diameter 46-52 μ Average diameter 49.2 μ

Biddulphia mobiliensis Bailey

Hustedt, Pt. 1, p. 840-2, Fig. 495, 1927-30

Observed inshore only during October through March; not recorded at salinities above 34.3°/oo.

Biddulphia rhombus (Ehrenberg) Wm. Smith [Pl. 10, Fig. 56, 58-60]

Hustedt, Pt. 1, p. 842-4, Fig. 496-8, 1927-30

B. rhombus and the forms *B. rhombus* f. *tetragona* Hustedt and *B. r.* f. *trigona* Hustedt were recorded; this species was observed in nine samples, five from Station P; cell diameter 17 to 102 μ.

Biddulphia alternans (Bailey) van Heurck [Pl. 10, Fig. 55]

Hendey, p. 102, Pl. XXV, Fig. 5, 1964

Restricted to inshore stations except Station N, middepth, June.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																																				
N																															a					
G																																				
O																			a	c		.c	c													
H																																				
P							c			c	d	c		c			a			c												e	d			
Avg/1	0			0			11			172			11			<1			78			25			0			0			1,250			0		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

8,928 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 0% Inshore stations (H-P) 18%

Surface samples 4% Middepth samples 8% Bottom samples 7%

Measurements:

No. cells measured 1 Average surface area (square microns) per cell 1,120

Range in length 23 μ Average length 23 μ

Range in diameter 15 μ Average diameter 15 μ

Biddulphia aurita (Lyngbye) Brebisson and Godey [Pl. 10, Fig. 57]

Hendey, p. 102, Pl. XXV, Fig. 5, 1964

Inshore stations only in October, November, December, February, March, April, and July.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F												
N												
G												
O					c c c			c c	c d			
H												
P			d	d d	c		c				E E	d
Avg/1	0	0	139	356	97	0	50	22	328	0	8,194	278

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

5,030 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 0% Middle stations (G-O) 0% Inshore stations (H-P) 18%

Surface samples 6% Middepth samples 8% Bottom samples 7%

Measurements:

No. cells measured 4 Average surface area (square microns) per cell 1,988

Range in length 18-56 μ Average length 33.7 μ

Range in diameter 14-26 μ Average diameter 18.8 μ

Hemiaulus Ehrenberg

Hemiaulus sinensis Greville

Hustedt, Pt. 1, p. 875-6, Fig. 519, 1927-30

Frequent and abundant; approximately the same frequency at all sampling depths and stations. A closely related species enumerated from live material as *H. hauckii,* was found to be *H. sinensis* when examined critically in permanent slides. Our findings indicate the possibility that *H. hauckii* is synonymous with *H. sinensis.*

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F	b		c c c			d d	a b a	b b	c c	b b	a	
N	c	a			c	a a	b b		c	c		b b
G	c c C			b	c c b	c	a		c b b	d d		b c
O	b c				b	c b b				c	a	b
H	c c	F E E				a				d D		c d
P	E			d		a b a	c a a		d	E D D		E E d
Avg/1	1,397	9,423	44	157	87	182	9	129	2,460	10	<1	5,211

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

5,841 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 37% Middle stations (G-O) 36% Inshore stations (H-P) 33%

Surface samples 42% Middepth samples 39% Bottom samples 26%

Measurements:

No. cells measured 15 Average surface area (square microns) per cell 1,712

Range in length 56-99 μ Average length 77.1 μ

Range in diameter 3-24 μ Average diameter 12.4 μ

Hemiaulus membranaceus Cleve

Cupp, p. 170, Fig. 120, 1943

More frequent at offshore and middle stations than at inshore stations.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																			D	b	b										c			c		
N	d			a			a						d						b	b					b						a			b		
G							D			c									c			a									b			D		b
O																												b	D	c	b					
H																																				E
P			c	E												a											c			D	c			c		

Avg/1 86 139 139 22 69 <1 189 1 28 354 28 701

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,814 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 21% Middle stations (G-O) 18% Inshore stations (H-P) 11%

Surface samples 26% Middepth samples 14% Bottom samples 10%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 5,510

Range in length 37-64 μ Average length 48.0 μ

Range in diameter 31-170 μ Average diameter 57.4 μ

Eucampia Ehrenberg

Eucampia zodiacus Ehrenberg

Hustedt, Pt. 1, p. 772-4, Fig. 451, 1927-30

Recorded in the living state only once.

Eucampia cornuta (Cleve) Grunow

Hustedt, Pt. 1, p. 774, Fig. 452, 1927-30

Recorded from only seven samples (August, October, November, March, and July); 100 to 10,000 cells/liter; length 45 to 119 μ (average 76 μ); diameter 9 to 34 μ (average 17 μ).

Triceratium Ehrenberg

Triceratium favus Ehrenberg [Pl. 10, Fig. 54]

Hustedt, Pt. 1, p. 798-801, Fig. 463-4, 1927-30

Scarce and sporadic distribution; recorded from six samples (December, February, April, and May); present offshore during April and May; the form *T. favus* f. *quadrata* Grunow was recorded from Station F during April.

Triceratium dubium Brightwell

Hustedt, Pt. 1, p. 806, Fig. 469, 1927-30

Cupp, p. 164-5, Fig. 114, 1943

Observed only in permanent slides.

Lithodesmium Ehrenberg

Lithodesmium undulatum Ehrenberg

Hustedt, Pt. 1, p. 789-91, Fig. 461, 1927-30

Observed primarily at inshore stations during January, February, March, April, June, and July. Although this species was well known to us, it was not observed in live counts prior to January.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																			a	b																
N																																				
G																																				
O																								a												
H																		a			c	D	b	c	b			c				a	b			c
P																					c	c			D								D	D		
Avg/1	0			0			0			0			0			<1			308			147			11			0			561			33		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,582 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 1% Inshore stations (H-P) 21%

Surface samples 4% Middepth samples 11% Bottom samples 10%

Measurements:

No. cells measured 5 Average surface area (square microns) per cell 6,321

Range in length 24-77 μ Average length 48.0 μ

Range in diameter 33-60 μ Average diameter 43.9 μ

Bellerochea van Heurck

Bellerochea malleus (Brightwell) van Heurck [Pl. 8, Fig. 42]

Hustedt, Pt. 1, p. 782-3, Fig. 456, 1927-30

Almost completely restricted to inshore stations where it was recorded in 64% of samples; occurred in bloom concentrations 27 times, representing 57% of the recordings for this species; no cells observed during the month of September; two varieties, *B. malleus* v. *biangulata* Peragallo and *B. malleus* v. *tetragona* van Heurck, were recorded.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																																c				
N																																				
G																																				
O																																				
H	E	E	C					D	D				D								D	b	d	c		b	c			b	a	a	b		D	c
P		D	c				E	E	D	D	D	E	b	c	D	D	b			D	D	d	D	D	b	a	b		D		c	D	E	E	F	E
Avg/1	5,086			0			5,486			2,244			605			104			756			898			16			169			1,306			13,183		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,414 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 0% Inshore stations (H-P) 64%

Surface samples 17% Middepth samples 25% Bottom samples 24%

Measurements:

No. cells measured 23 Average surface area (square microns) per cell 7,069

Range in length 28-100 μ Average length 43.4 μ

Range in diameter 21-70 μ Average diameter 26.0 μ

Climacodium Grunow

Climacodium frauenfeldianum Grunow

Hustedt, Pt. 1, p. 776-7, Fig. 453, 1927-30

Most frequent at middle stations and at salinities 34.4°/oo or higher; high overall frequency (24% of samples) and low level of abundance; blooms at offshore stations in February, at middle stations in November and April, and at inshore stations in April and May.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	Jan. S M B	Feb. S M B	Mar. S M B	1966 Apr. S M B	May S M B	June S M B	July S M B
F					a	c c	D a		a	b		
N					a a b	a				b		b
G				c c				c c a	b D	c c c		
O				c D	b c	a		b c c	c c	c b c		c
H									D D d	a		
P	c c				c				d D D	c c D	b	b
Avg/1	36	0	0	181	53	26	278	122	1,362	405	4	42

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,745 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 18% Middle stations (G-O) 33% Inshore stations (H-P) 21%

Surface samples 26% Middepth samples 26% Bottom samples 19%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 5,728

Range in length 56-82 μ Average length 72.6 μ

Range in diameter 100-185 μ Average diameter 136.3 μ

Streptotheca Shrubsole

Streptotheca tamesis Shrubsole

Hendey, p. 113, Pt. VII, Fig. 2, 1964

Recorded mainly from inshore stations (31% of samples); observed in samples from middle stations in January and from offshore stations in February and March.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	Jan. S M B	Feb. S M B	Mar. S M B	1966 Apr. S M B	May S M B	June S M B	July S M B
F								b				
N							c a					
G						b						
O						a						
H		c c	c c			a	b D	b c b				
P		c	D		b b c	b	D	D D D			D	
Avg/1	0	64	140	0	22	7	386	796	0	0	139	17

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

856 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 3% Inshore stations (H-P) 31%

Surface samples 11% Middepth samples 15% Bottom samples 11%

Measurements:

No. cells measured 7 Average surface area (square microns) per cell 11,670

Range in length 58-120 μ Average length 77.9 μ

Range in diameter 51-155 μ Average diameter 74.9 μ

Cerataulina Peragallo

Cerataulina pelagica (Cleve) Hendey

Hendey, p. 113, Pl. IV, Fig. 4, 1964

A frequent and abundant species; auxospores and resting spores recorded from middepth and bottom samples at Station H during October.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	1965 Aug. M	1965 Aug. B	1965 Sept. S	1965 Sept. M	1965 Sept. B	1965 Oct. S	1965 Oct. M	1965 Oct. B	1965 Nov. S	1965 Nov. M	1965 Nov. B	1965 Dec. S	1965 Dec. M	1965 Dec. B	1966 Jan. S	1966 Jan. M	1966 Jan. B	1966 Feb. S	1966 Feb. M	1966 Feb. B	1966 Mar. S	1966 Mar. M	1966 Mar. B	1966 Apr. S	1966 Apr. M	1966 Apr. B	1966 May S	1966 May M	1966 May B	1966 June S	1966 June M	1966 June B	1966 July S	1966 July M	1966 July B
F			d															c	c				a												
N			c						b										d	a			b	c	b		b								
G										c			c		c				b	c	b	b			d		b	c		b				E	
O									b		c					a		c	a		c	a	b	b			c	b							
H				E	D	D	F	E	F							c	a					c					c				E	E		F	E
P	E		E	b	D		b	D	c	c	d			c	d	d	d					D	D		d	d	d			a				D	D
Avg/1	3,978			3,533			23,220			181			133			325			103			843			481			23			2,083			13,611	

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

2,572 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 17% Middle stations (G-O) 33% Inshore stations (H-P) 44%

Surface samples 36% Middepth samples 26% Bottom samples 32%

Measurements:

No. cells measured 22 Average surface area (square microns) per cell 3,888

Range in length 40-150 μ Average length 67.3 μ

Range in diameter 5-38 μ Average diameter 18.4 μ

Family: ANAULACEAE

Eunotogramma marinum (Wm. Smith) Peragallo [Pl. 14, Fig. 107]

Hustedt, p. 10, Pl. 4, Fig. 10-17, 1955

Observed only in permanent slides during August and June (Station P); length 14 to 21 μ; diameter 12 μ.

Family: CHAETOCERACEAE

Chaetoceros Ehrenberg

Chaetoceros atlanticum Cleve [Pl. 2, Fig. 7-8]

Hustedt, Pt. 1, p. 641-8, Fig. 383-6, 1927-30

C. atlanticum and two varieties, *neapolitana* (Schroder) Hustedt and *skeleton* (Schutt) Hustedt, were recorded; not abundant; most frequent offshore.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																d	a	c		b	c	c														
N																	b	c	b	a					b		c				b				
G							c			c			b				c				b					d							d				
O																d												d								
H																									d											
P																										b										
Avg/1	0			0			13			15			6			314			32			69			228			167			140			0		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

21,929 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 12% Inshore stations (H-P) 3%

Surface samples 14% Middepth samples 10% Bottom samples 8%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 456

Range in length 18-24 μ Average length 21.1 μ

Range in diameter 7-17 μ Average diameter 10.8 μ

Chaetoceros densum Cleve [Pl. 15, Fig. 113]

Hustedt, Pt. 1, p. 651-3, Fig. 368, 1927-30

Frequently encountered, but not important numerically or with regard to its surface area composition; months of peak abundance were November and December; recorded in all months except September; rare at inshore stations.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F													c	b	c	c				b	a	c						b								
N													c		b	b	b	a		c	a				c	c					c		c		
G							d					c	c	d	d				b				b	b									c	c		
O		c						b				D			a		c		c		c		b	c			c			b						
H							c																													
P												b			c																					
Avg/1	31			0			103			568			527			62			31			65			47			6			10			58		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

4,149 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 26% Middle stations (G-O) 29% Inshore stations (H-P) 6%

Surface samples 14% Middepth samples 18% Bottom samples 29%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 2,410

Range in length 23-43 μ Average length 38.2 μ

Range in diameter 15-33 μ Average diameter 20.1 μ

Chaetoceros eibenii Grunow

Hustedt, Pt. 1, p. 653-5, Fig. 369, 1927-30

Recorded from five samples (August, December, and April).

Chaetoceros boreale Bailey

Hustedt, Pt. 1, p. 661-5, Fig. 375, 1927-30

November through March; infrequent (11 samples).

Chaetoceros coarctatum Lauder [Pl. 3, Fig. 13]

Hustedt, Pt. 1, p. 655-7, Fig. 370, 1927-30

Infrequent (6% of all samples) but usually abundant when it occurred; bloomed in August and November.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F											b										c															
N										D	c					c			c											b					
G																																				
O	D					b									b	a			c		c															
H																																				
P		E			b																														
Avg/1	1,667			8			0			182			1			15			78			0			0			0			1			0		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

2,520 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 14% Inshore stations (H-P) 3%

Surface samples 8% Middepth samples 6% Bottom samples 6%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 3,968

Range in length 31-56 μ Average length 45.3 μ

Range in diameter 24-33 μ Average diameter 27.9 μ

Chaetoceros glandazii Mangin

Hendey, p. 121, Pl. XVII, Fig. 5, 1964

Frequent (26% of all samples), but not usually abundant; recorded twice in bloom concentrations (March and April); chains characteristically covered by large numbers of epiphytes. Both inner and terminal setae heavily spined, whereas typical specimens described by Hendey (1964); only outer setae spined; valve process, a diagnostic characteristic, best demonstrated by mounting chains of cells under cover slips. *C. glandazii* cannot always be clearly separated from related species such as *C. danicum* unless this procedure is routinely followed in the analysis of live material.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F													a			c	a		c		b				c											
N									a				a			a		a	a	c				b		c									
G							d	c					c	c	a		c	c	b	b	c	a			E	d	c	a								
O																c	c	a	c	b	b	c	b		c	d	c							c		
H																			c						d	d	d									
P							d	c					c			c		d				E	d	d	d	d	c									
Avg/1	0			0			743			0			59			234			141			1,261			2,328			<1			0			4		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

8,333 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 37% Inshore stations (H-P) 21%

Surface samples 29% Middepth samples 25% Bottom samples 24%

Measurements:

No. cells measured 14 Average surface area (square microns) per cell 1,200

Range in length 20-40 μ Average length 28.1 μ

Range in diameter 8-32 μ Average diameter 13.6 μ

Chaetoceros danicum Cleve

Hustedt, Pt. 1, p. 659-60, Fig. 373, 1927-30

Recorded only from six samples (September, October, November, March, and July).

Chaetoceros tetrastichon Cleve

Hustedt, Pt. 1, p. 657-8, Fig. 371, 1927-30

Rare; attached to the loricas of tintinnids; surface and middepth samples at Station N; two specimens measured were 10 and 14 μ in diameter.

Chaetoceros convolutum Castracane f. *trisetosa* Brunel

Brunel, p. 93-97, Pl. 14, Fig. 1-5, 1962

Recorded from one sample at Station G (July), five samples from Station H (June and July); abundant when found but not significant with regard to surface area because of its small size.

Chaetoceros peruvianum Brightwell

Hustedt, Pt. 1, p. 671-4, Fig. 380-1, 1927-30

Frequently encountered (29% of all samples) but seldom exceeding 100 cells/liter; specimens examined resembled *C. peruvianum* f. *gracilis* (Schroder) Hustedt.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
	F					a	b	a b b				a	
	N				a	b	a	a b b		a	a		
	G			d		a c	b a b	b	a a	a		c	D b b
	O					c c c	b a	a b b		b	b	b a	b
	H		b				b b			b c d	c		c d b
	P			b	c b	b a	a		a	a	b c		D D
Avg/1		0	3	144	17	53	30	19	<1	338	31	20	1,978

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

6,134 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 37% Inshore stations (H-P) 31%

Surface samples 31% Middepth samples 33% Bottom samples 24%

Measurements:

No. cells measured 4 Average surface area (square microns) per cell 1,630

Range in length 24-34 μ Average length 28.3 μ

Range in diameter 9-28 μ Average diameter 18.3 μ

Chaetoceros decipiens Cleve

Hustedt, Pt. 1, p. 675-7, Fig. 383, 1927-30

A frequent species during October, December, January, and April; recorded from 29% of all samples and 89% of samples in January.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F									a	a					c	c	c	d	d		c				a											
N		c												a	c	b	a	a	d	c	c				c			a							
G							d						c			c	c	c	c	c	c			a		c	c				a					
O									c				d	d	d	b	c	d	c	c	c	b			c							b	c			
H																d			c						E	d	d									
P									d				c	d	d	E	d	d				c						c								

Avg/1 44 0 982 <1 1,149 2,384 506 41 1,556 28 16 0

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

10,030= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 28% Middle stations (G-O) 36% Inshore stations (H-P) 19%

Surface samples 35% Middepth samples 21% Bottom samples 28%

Measurements:

No. cells measured 13 Average surface area (square microns) per cell 997

Range in length 21-28 μ Average length 23.4 μ

Range in diameter 11-30 μ Average diameter 21.3 μ

Chaetoceros mitra? (Bailey) Cleve

Hustedt, Pt. 1, p. 677-679, Fig. 384, 1927-30

Brunel, p. 102-4, Pl. 16 and 17, 1962

Infrequent; recorded only from offshore stations in October, December, February, March, and April; resting spores not observed; cell diameter 7-10 μ.

Chaetoceros lorenzianum Grunow

Hustedt, Pt. 1, p. 679-81, Fig. 385, 1927-30

A frequent and abundant species; generally most frequent in months where the related species, *C. decipiens,* was least abundant. Peak months were August, September, October, June, and July; present in only three samples from offshore stations.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F									a												b															
N		c																				b													
G	d	E								c												b	b		d	d	b	a		b	c	d		d	b	
O						b				b									c					c		c		d	b	b						
H	E	d		E	E	d	b		d												c					c		b	c		E	E		E	E	E
P	F	F	F				E	E		c		c										d	c	c				c			E		d	d	E	

Avg/1 49,794 4,092 2,617 86 0 0 12 175 499 228 4,264 8,335

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

14,577= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 31% Inshore stations (H-P) 42%

Surface samples 31% Middepth samples 28% Bottom samples 18%

Measurements:

No. cells measured 20 Average surface area (square microns) per cell 686

Range in length 14-42 μ Average length 20.3 μ

Range in diameter 9-42 μ Average diameter 16.9 μ

Chaetoceros lauderi Ralfs [Pl. 1, Fig. 3-4]
Hustedt, Pt. 1, p. 683-4, Fig. 387, 1927-30

This species and *Chaetoceros teres* Cleve are primarily distinguished on the basis of resting spores; this identification was based upon spores found in artificially cultivated specimens. These counts may include *C. teres* since spores were not observed.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	Jan. S M B	Feb. S M B	Mar. S M B	1966 Apr. S M B	May S M B	June S M B	July S M B
F				a		b	d c d		c		c	
N				a		a	c c	b	c c			
G					c	c b d	b		c b		c F	
O	E				c c	c d d		c c	c c			
H						a			D c			
P				d		D D D		D d d	D D d			
Avg/1	3,611	0	0	79	105	1,476	304	604	1,331	0	8,529	0

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

3,681 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 26% Inshore stations (H-P) 18%

Surface samples 19% Middepth samples 22% Bottom samples 22%

Measurements:

No. cells measured 23 Average surface area (square microns) per cell 2,716

Range in length 13-52 μ Average length 34.6 μ

Range in diameter 10-45 μ Average diameter 25.0 μ

Chaetoceros compressum Lauder
Hustedt, Pt. 1, p. 684-7, Fig. 388-9, 1927-30

The most frequent and abundant species of *Chaetoceros* encountered; overall frequency was 39%; resting spores common; auxospores noted at Station O during March.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	Jan. S M B	Feb. S M B	Mar. S M B	1966 Apr. S M B	May S M B	June S M B	July S M B
F					b	d d d		c d c			c	
N	c				a	b			a			c c
G	E E F		E			d d	c	b	d d c		E	c c
O	F F F				d d d	d d e	c	d E E	d c		c	
H	E F E	F E	b	c c	c		d		F F E		d	d d
P	F F G	d	E d E	d d d	d	d d d		E a d	E E d	c	F F e	d
Avg/1	183,167	31,667	4,389	975	582	3,074	109	5,972	33,006	50	21,554	365

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

12,658= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 42% Inshore stations (H-P) 57%

Surface samples 37% Middepth samples 43% Bottom samples 37%

Measurements:

No. cells measured 27 Average surface area (square microns) per cell 790

Range in length 9-23μ Average length 14.3μ

Range in diameter 5-29μ Average diameter 17.7μ

Chaetoceros didymum Ehrenberg [Pl. 4, Fig. 20-21]
Hustedt, Pt. 1, p. 688-93, Fig. 390-4, 1927-30

A common species (24% of all samples) infrequent at offshore stations; chains of this species often covered with epiphytic flagellates; *C. didymum* and the varieties *protuberans* (Lauder) Gran et Yendo and *anglica* (Grunow) Gran recorded; resting spores common.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F						c			b		b	
N									e d c		c d d	E b
G	E	d					c	c	d d c	c		
O	e					c		c c	d e E	d	d	F e e
H	F F F		e e			d d		d e	F E E	c c	e d	c d
P												

Avg/1 77,033 389 1,756 0 0 478 15 999 13,282 178 1,728 10,860

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

22,371= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 25% Inshore stations (H-P) 43%

Surface samples 31% Middepth samples 24% Bottom samples 18%

Measurements:

No. cells measured 20 Average surface area (square microns) per cell 447

Range in length 11-26 μ Average length 17.9 μ

Range in diameter 6-30 μ Average diameter 12.5 μ

Chaetoceros constrictum Gran
Hustedt, Pt. 1, p. 694, Fig. 395, 1927-30

Infrequent (8% of all samples); not recorded in bloom concentration; resting spores observed in December (Station O, middepth).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F					c			d d				
N												
G					c		c					
O					d d d							c c
H												d
P						b d d		d	d	b		c

Avg/1 0 0 0 0 494 564 17 275 61 <1 0 146

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

12,224= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 10% Inshore stations (H-P) 11%

Surface samples 8% Middepth samples 11% Bottom samples 6%

Measurements:

No. cells measured 5 Average surface area (square microns) per cell 818

Range in length 15-31 μ Average length 22.0 μ

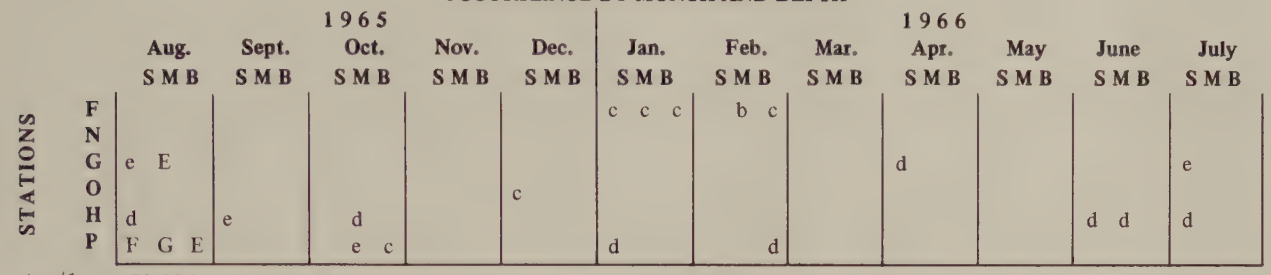
Range in diameter 13-28 μ Average diameter 18.6 μ

Chaetoceros affine Lauder [Pl. 3, Fig. 10]

Hustedt, Pt. 1, p. 695-9, Fig. 396-8, 1927-30

C. affine and *C. affine* v. *willei* (Gran) Hustedt were encountered; the former was most frequent from August through October and July, the latter from December through February; overall frequency was 11%.

OCCURRENCE BY MONTH AND DEPTH



Avg/1 79,056 1,111 1,139 0 17 497 94 0 289 0 417 1,189

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

36,496 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 7% Inshore stations (H-P) 18%

Surface samples 15% Middepth samples 10% Bottom samples 7%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 274

Range in length 9-21μ Average length 14.6μ

Range in diameter 6-13μ Average diameter 9.4μ

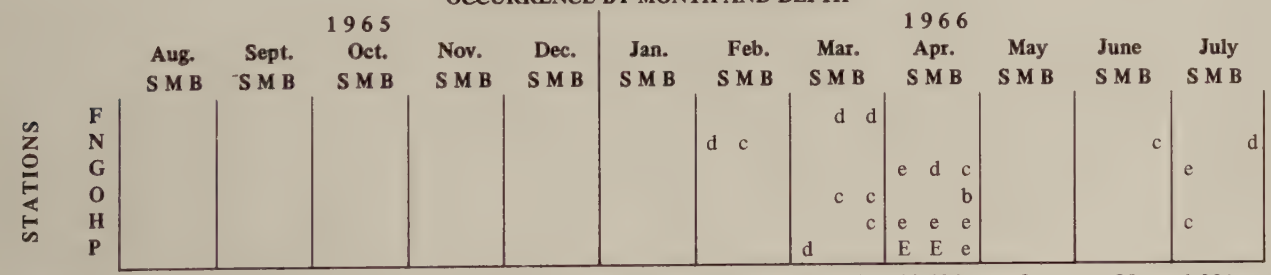
Chaetoceros costatum Pavillard

Hustedt, Pt. 1, p. 699-701, Fig. 399, 1927-30

Cupp, p. 127, Fig. 79, 1943

This species was not detected prior to February, 1966; recorded in all succeeding months except May; not sufficiently frequent to be a significant species but reaching bloom concentrations on occasion (Station P, April); resting spores present in April (Stations H and P).

OCCURRENCE BY MONTH AND DEPTH



Avg/1 0 0 0 0 0 0 318 617 13,494 0 25 1,281

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

36,231 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 8% Middle stations (G-O) 10% Inshore stations (H-P) 12%

Surface samples 10% Middepth samples 8% Bottom samples 12%

Measurements:

No. cells measured 13 Average surface area (square microns) per cell 276

Range in length 8-19 μ Average length 11.8 μ

Range in diameter 8-18 μ Average diameter 11.7 μ

Chaetoceros laciniosum Schütt [Pl. 4, Fig. 16-18]

Hustedt, Pt. 1, p. 701-4, Fig. 401a and 401b, 1927-30

Uncommon; recorded during August, September, October, January and May; small specimens of this species are easily confused with *C. pelagicum;* cell length 10 to 21 μ, diameter 7 to 27 μ.

Chaetoceros pelagicum Cleve

Hustedt, Pt. 1, p. 707-7, Fig. 402, 1927-30

The second most important species of *Chaetoceros* based on surface area composition; present in 27% of all samples; least frequent at offshore stations; peak numbers registered in August.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F								c c	c			
N	c				c					a b		
G	F F F		c		c d	c c d		c	e d c			F
O	E e E	c				d	c	c b c	a d c			
H	E F	E			d			d	e d		e e c	c
P	G F F	d c	E			e c		d c	d E E	d c		
Avg/1	186,713	2,392	2,893	0	306	954	28	967	8,381	590	2,117	7,811

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

30,959 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 10% Middle stations (G-O) 36% Inshore stations (H-P) 36%

Surface samples 36% Middepth samples 29% Bottom samples 17%

Measurements:

No. cells measured 5 Average surface area (square microns) per cell 323

Range in length 17-23 μ Average length 20.2 μ

Range in diameter 7-9 μ Average diameter 8.0 μ

Chaetoceros breve Schütt [Pl. 3, Fig. 9]

Hustedt, Pt. 1, p. 707-8, Fig. 403a and 403b, 1927-30

Overall frequency 15%; most frequent inshore; not recorded from salinities below 32.4°/oo.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F								a d d				
N							b					
G									d c		c d	
O						c	c	c c d	c			
H				c					d d E	c b		d c
P								c c d	E d d	d d c	d	c
Avg/1	0	0	0	9	0	50	9	414	3,903	355	972	183

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

12,936 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 6% Middle stations (G-O) 14% Inshore stations (H-P) 26%

Surface samples 17% Middepth samples 15% Bottom samples 14%

Measurements:

No. cells measured 9 Average surface area (square microns) per cell 773

Range in length 14-29 μ Average length 21.0 μ

Range in diameter 9-26 μ Average diameter 18.4 μ

Chaetoceros messanense Castracane

Hustedt, Pt. 1, p. 718-20, Fig. 410, 1927-30

Recorded only from permanent slides (Station G, April, middepth); length 16 to 19 μ, diameter 23 to 33 μ.

Chaetoceros orientalis? Schiller [Pl. 15, Fig. 111]

Hustedt, Pt. 1, p. 721-3, Fig. 412, 1927-30

Recorded only once (Station P, July, middepth); cell length 4 μ, diameter 5 μ, a single chloroplast.

Chaetoceros wighami? Brightwell

Hustedt, Pt. 1, p. 724-5, Fig. 414, 1927-30

Recorded from three samples during May through June; cell length 9 μ, diameter 6 μ.

Chaetoceros curvisetum Cleve [Pl. 5, Fig. 22]

Hustedt, Pt. 1, p. 737-9, Fig. 426, 1927-30

An abundant species of *Chaetoceros;* present in 26% of all samples; relatively uniform distribution.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F		c				c c c	e c c	c d			c	
N			b		c a	a	c				a	
G			c	c		c d d	c	b	d		E d F	b
O				c	d d	c d	c c				c	b
H			c						E d d		E d	E E E
P				d	c d	d d d			E d	c	E b	
Avg/1	0	11	67	131	361	1,025	733	78	5,119	33	13,546	4,731

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

13,140 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 22% Middle stations (G-O) 29% Inshore stations (H-P) 28%

Surface samples 29% Middepth samples 25% Bottom samples 25%

Measurements:

No. cells measured 11 Average surface area (square microns) per cell 761

Range in length 19-34 μ Average length 26.6 μ

Range in diameter 5-15 μ Average diameter 9.1 μ

Chaetoceros pseudocurvisetum Mangin

Hustedt, Pt. 1, p. 739-40, Fig. 427, 1927-30

Infrequent, but relatively abundant when observed.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. SMB	Sept. SMB	Oct. SMB	Nov. SMB	Dec. SMB	1966 Jan. SMB	Feb. SMB	Mar. SMB	Apr. SMB	May SMB	June SMB	July SMB
F												
N												
G												
O			c									
H			d e c									
P			e e d					c				
Avg/1	0	0	4,722	0	0	0	0	44	0	0	0	0

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

13,532 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 0% Middle stations (G-O) 1% Inshore stations (H-P) 10%

Surface samples 6% Middepth samples 3% Bottom samples 3%

Measurements:

No. cells measured 1 Average surface area (square microns) per cell 739

Range in length 21 μ Average length 21.0 μ

Range in diameter 11 μ Average diameter 11.0 μ

Chaetoceros debile Gran

Hustedt, Pt. 1, p. 740-3, Fig. 428, 1927-30

Sporadic; August, October, November, December, March, and July. Resting spores were not observed.

Chaetoceros anastomosans Grunow [Pl. 15, Fig. 114]

Hustedt, Pt. 1, p. 743-5, Fig. 429-30, 1927-30

Infrequent, not abundant; recorded offshore in January (Station N, bottom), February (Station N, surface), and March (Station F, bottom); length 14 μ, diameter 12 to 18 μ.

Chaetoceros radicans Schütt [Pl. 8, Fig. 40]

Hustedt, Pt. 1, p. 746-8, Fig. 431, 1927-30

Infrequent, occasionally abundant; recorded from six samples (December, May, June, and July); length 12 μ, diameter 12 μ.

Chaetoceros cinctum Gran

Hustedt, Pt. 1, p. 748-9, Fig. 432, 1927-30

Recorded from five samples (January, February, and July); length 10 to 20 μ, diameter 6 to 13 μ.

Chaetoceros tortissimum Gran [Pl. 2, Fig. 5]

Hustedt, Pt. 1, p. 751, Fig. 434, 1927-30

Observed in 10 samples during October through January and March; length 8 μ, diameter 15 to 30 μ; this species may be confused with large specimens of *C. compressum,* chains of which are twisted like those of *C. tortissimum.*

Chaetoceros sociale Lauder [Pl. 4, Fig. 19]

Hustedt, Pt. 1, p. 751-3, Fig. 435, 1927-30

Not frequent; characteristic spherical aggregations of cells were observed in October, November, and January and affected the counts accordingly.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																																				
N																																				
G																																				
O																																				
H												c									d	c													
P							d	d	c	e	F	F					c	d																c		
Avg/1	0			0			1,606			14,850			0			222			72			0			0			0			0			49		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

52,356 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 0% Inshore stations (H-P) 15%

Surface samples 6% Middepth samples 6% Bottom samples 6%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 191

Range in length 8-10 μ Average length 8.7 μ

Range in diameter 6-8 μ Average diameter 7.0 μ

Chaetoceros diversum Cleve

Hendey, p. 130, Pl. XVII, Fig. 4, 1964

Cupp, p. 133, Fig. 88, 1943

Infrequent, 6% of samples. Our specimens more closely resembled *C. laevis* which Curl (1959) has synonymized with *C. diversum*.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F										a						c																				
N																																		c	c	
G																																				
O				e		d				b	b																				e	d		e	d	d
H																																				
P	e	e	e						d																											
Avg/1	3,333			2,589			278			9			0			19			0			0			0			0			2,292			3,082		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

83,333 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 3% Inshore stations (H-P) 18%

Surface samples 8% Middepth samples 8% Bottom samples 7%

Measurements:

No. cells measured 2 Average surface area (square microns) per cell 120

Range in length 9 μ Average length 9.0 μ

Range in diameter 7 μ Average diameter 7.0 μ

Chaetoceros sp. "A" [Pl. 5, Fig. 24-25]

Cells small, oval, embedded linearly in a transparent matrix. Cells not linked by the crossing of setae of adjacent cells; therefore, this species should be assigned to the section *Simplicia* Ostenfeld. "Chains" composed of 10 to 30 cells. Typically these cells appear as pairs (dividing cells) separated by spaces greater than twice the length of individual cells.

Cells variable, from 4 to 8 μ in length and from 5 to 13 μ in diameter. Girdle zone visible with phase equipment (970X). Valve faces convex, strongly attenuated at bases of setae. Chromatophores plate-like, one or two in number.

This small species was readily observed since it adhered to the surface film of subsamples.

Pencil sketches of unknown *Chaetoceros* spp., made during early months of study, indicated that this species was also present in December, February, and March (X).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																												b					c			c	c
N													x															c	c							
G														x					x			x														
O																									e											
H																									d											
P																									e	d										
																									e	d										
Avg/1	0			0			0			0			0			0			0			0			3,317			44			11			53		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

68,493 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 8% Middle stations (G-O) 3% Inshore stations (H-P) 6%

Surface samples 7% Middepth samples 7% Bottom samples 3%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 146

Range in length 4-8 μ Average length 6.4 μ

Range in diameter 5-13 μ Average diameter 7.1 μ

Chaetoceros spp.

Unidentified specimens of *Chaetoceros* were enumerated as *Chaetoceros* spp. Aberrant or unusual specimens of species already known to us probably made up a percentage of this number but specimens were also observed which resembled *Chaetoceros simplex* Ostenfeld, *C. difficilis* Cleve, *C. gracilis* Schütt, *C. perpusillus* Cleve, and *C. vixvisibilis* Schiller. Numbers of *Chaetoceros* spp. were generally small compared to identified specimens of *Chaetoceros.* Since these counts represent several species neither measurements nor bloom determinations could be attempted.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F										c	c														c			b								
N													c		b											c					c					
G							d	d		c			c	d	c		d	d		c	c	d	c		e							c		e	c	
O			c	c								c	d												d											
H	e	e				e		d	e			c				e	c							d				c		d	e	e	b	e		
P							e	e	e									d				d			e	c	e					e					
Avg/1	4,217			5,008			8,910			103			240			1,942			24			93			5,260			262			7,285			2,785		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

_____ = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) _____ Middle stations (G-O) _____ Inshore stations (H-P) _____

Surface samples _____ Middepth samples _____ Bottom samples _____

Measurements:

No. cells measured _____ Average surface area (square microns) per cell _____

Range in length _____ Average length _____

Range in diameter _____ Average diameter _____

Suborder: Rhizosoleniineae
Family: BACTERIASTRACEAE
Bacteriastrum Shadbolt
Bacteriastrum delicatulum Cleve [Pl. 7, Fig. 36]
Hustedt, Pt. 1, p. 612-5, Fig. 353, 1927-30
Frequent (28% of all samples); abundant inshore; frequent offshore only during January, February, and March.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
	F																d	d	d	d	c		c	d	c												
	N																b	c	c	b	c	c										b					
	G	d	E	E													c	b	d	c		b			b							a			c		
	O													c		c	a			c	b	c		b	c	c		c									
	H				E	E			c									c			d					E	E	d									
	P	F		d				c	d	E							b	d	c				d			e	d		d			E					
Avg/1		9,106			3,144			1,000			0			5			942			383			633			3,965			556			835			43		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

14,265 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N)	22%	Middle stations (G-O)	35%	Inshore stations (H-P)	28%
Surface samples	33%	Middepth samples	28%	Bottom samples	25%

Measurements:

No. cells measured	5	Average surface area (square microns) per cell	701
Range in length	21-27 μ	Average length	23.7 μ
Range in diameter	7-13 μ	Average diameter	9.4 μ

Bacteriastrum comosum? Pavillard [Pl. 1, Fig. 2]
Hustedt, Pt. 1, p. 622-3, Fig. 361, 1927-30
Observed only in permanent slides during the study. Observations of living specimens after the study support our tentative identification. Length 15 to 18 μ, diameter 14 μ.
Bacteriastrum hyalinum Lauder [Pl. 3, Fig. 11]
Hustedt, Pt. 1, p. 615-7, Fig. 354-5, 1927-30
Present in 27% of samples, not especially abundant. Both *B. hyalinum* and *B. hyalinum* v. *princeps* (Castracane) Ikari were observed.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. SMB	Sept. SMB	Oct. SMB	Nov. SMB	Dec. SMB	1966 Jan. SMB	Feb. SMB	Mar. SMB	Apr. SMB	May SMB	June SMB	July SMB
F						c c	c	d d	d			
N			b			b	d d c		c c b			
G					c	c b c	c	b c c	d d c	c		c
O			c	c	b	c b c	b	c c c	b b	d c		
H						b		c c	d			
P			d	d		d c d	c	d b	d d	d c		
Avg/1	0	0	212	108	42	448	607	405	1,494	311	0	17

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

8,025 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 22% Middle stations (G-O) 37% Inshore stations (H-P) 21%

Surface samples 28% Middepth samples 26% Bottom samples 26%

Measurements:

No. cells measured 8 Average surface area (square microns) per cell 701

Range in length 10-32 μ Average length 23.7 μ

Range in diameter 12-22 μ Average diameter 9.4 μ

Bacteriastrum elongatum Cleve

Hustedt, Pt. 1, p. 617-8, Fig. 357, 1927-30

Rare; recorded from Station O in August, Station G in April, and Station N in February.

Bacteriastrum biconicum Pavillard

Hustedt, Pt. 1, p. 618-9, Fig. 358, 1927-30

Recorded from two samples in January (Stations F and O) and one in May (Station G); cell length 26 μ, diameter 5 μ.

Bacteriastrum sp. "A"

Cells embedded in a transparent envelope which has a distinct, shiny appearance at low magnifications. Cells not interconnected by the fusion of setae except for cells which are probably recently divided. Setae 8 to 10 in number. Valve mantle beveled, giving the normal cell in girdle view a barrel-shaped appearance. Cell height 8 to 25 μ, diameter 11 to 15 μ. "Chains" of as many as 27 cells have been observed.

Sporadic (10% of all samples); most frequent in high salinities.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. SMB	Sept. SMB	Oct. SMB	Nov. SMB	Dec. SMB	1966 Jan. SMB	Feb. SMB	Mar. SMB	Apr. SMB	May SMB	June SMB	July SMB
F			d				a c					
N					d b		d c					
G			e c				c		d	c		c
O					d d	d						c c
H												
P					d				d	d		E
Avg/1	0	0	1,135	0	334	78	198	0	708	239	0	2,301

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

17,271 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 11% Middle stations (G-O) 15% Inshore stations (H-P) 6%

Surface samples 17% Middepth samples 10% Bottom samples 6%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 579

Range in length 8-25 μ Average length 14.7 μ

Range in diameter 11-15 μ Average diameter 12.5 μ

Family: LEPTOCYLINDRACEAE

Leptocylindrus Cleve

Leptocylindrus danicus Cleve

Hustedt, Pt. 1, p. 558-9, Fig. 318-9, 1927-30

Frequent (57% of all samples), most abundant inshore; occurred in bloom concentrations 30 times during this study.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S	Aug. M	Aug. B	Sept. S	Sept. M	Sept. B	Oct. S	Oct. M	Oct. B	Nov. S	Nov. M	Nov. B	Dec. S	Dec. M	Dec. B	1966 Jan. S	Jan. M	Jan. B	Feb. S	Feb. M	Feb. B	Mar. S	Mar. M	Mar. B	Apr. S	Apr. M	Apr. B	May S	May M	May B	June S	June M	June B	July S	July M	July B
	F						c							a				d	c													b	b	c			c
	N						c		a											d	c		c	a	c	c	b		b	c		c	c	b	c		c
	G		c	E				c						d	c	d		b	d			c	c	c		b	a	d	c	c			D		D		c	b
	O				c						c	c	c				c		d	b	b	c	c	c				d	d		c	b	c	c	c	c	E	d	
	H	E	E			E			d									c			c			c				d	d	D		a	E	F	E	d	E	E	E
	P	F	F	F	c	d				d	d	c	E	d	d	d	d	E	E	c	d	d	F	F	F	E	E	d	c	c	d	F	F	F	E		E

Avg/1 86,231 1,782 487 1,144 1,236 2,504 648 50,856 8,597 1,017 35,853 16,832

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

8,453 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 44% Middle stations (G-O) 57% Inshore stations (H-P) 69%

Surface samples 58% Middepth samples 61% Bottom samples 51%

Measurements:

No. cells measured 23 Average surface area (square microns) per cell 1,183

Range in length 21-75 μ Average length 49.6 μ

Range in diameter 3-10 μ Average diameter 7.6 μ

Leptocylindrus minimus Gran

Hustedt, Pt. 1, p. 560, Fig. 321, 1927-30

Less frequent and abundant than *L. danicus;* distinguished from *L. danicus* by its smaller size and the presence of two plate-like chloroplasts.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S	Aug. M	Aug. B	Sept. S	Sept. M	Sept. B	Oct. S	Oct. M	Oct. B	Nov. S	Nov. M	Nov. B	Dec. S	Dec. M	Dec. B	1966 Jan. S	Jan. M	Jan. B	Feb. S	Feb. M	Feb. B	Mar. S	Mar. M	Mar. B	Apr. S	Apr. M	Apr. B	May S	May M	May B	June S	June M	June B	July S	July M	July B
	F																						c	c										e		
	N																																			
	G																																			
	O		e	d																	c			c												
	H				e		c		d				c																		e			f	d	
	P			e				d	d	d	d	d	d											d							F	F	F	d	e	

Avg/1 2,478 2,600 271 463 0 0 24 511 0 0 49,514 10,556

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

33,784 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 3% Middle stations (G-O) 7% Inshore stations (H-P) 26%

Surface samples 15% Middepth samples 11% Bottom samples 10%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 296

Range in length 30-45 μ Average length 39.0 μ

Range in diameter 2-3 μ Average diameter 2.5 μ

Guinardia H. Peragallo

Guinardia flaccida (Castracane) Peragallo

Hendey, p. 141, Pl. V, Fig. 5, 1964

Birnhak *et al.*, p. 1, Fig. 1-2, 1967

The eighth most important species from the standpoint of cellular surface area; recorded from 45% of all samples, often in bloom concentration (29 times).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F													a		c	a	C	b		c	c		c	c					b							
N													a	c	C	b		a	C	c	c						c									
G	D	D	c		a		E	E	D				b	b	c	b	b			c	b	b		a					b		a			b	b	
O	b				c				b			D		b	b	c	c			a	b			b	a	b				b		c				
H	C	D	E	c	D	E	b	C	C	c	c									a			a					a					c	C	D
P				b	C		c	C	c	c	C	C	C	C	C	b	c	c		b	D	a		b			a		C	D	D			c	b	

Avg/1 1,594 1,726 3,987 239 218 111 285 44 32 353 7 360

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

404 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 26% Middle stations (G-O) 51% Inshore stations (H-P) 56%

Surface samples 36% Middepth samples 47% Bottom samples 51%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 24,740

Range in length 102-265 μ Average length 155.4 μ

Range in diameter 35-75 μ Average diameter 50.7 μ

Guinardia blavyana Peragallo

Hustedt, Pt. 1, p. 564, Fig. 323, 1927-30

Distinguished from *G. flaccida* by its distinctive intercalary bands; Balech (1967) tentatively identified this species from a plankton haul north of the Straits of Yucatan (February 27, 1965); not recorded from August through January, perhaps identified as *G. flaccida* during this period; present in all successive months.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																														b							
N																																				
G																			b															E		
O																			b	a						a		b								
H																															D	D		c		
P																				b	C	D			D	D		D			D			E		d

Avg/1 0 0 0 0 0 0 58 333 417 335 210 2,233

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

321 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 8% Inshore stations (H-P) 17%

Surface samples 11% Middepth samples 7% Bottom samples 8%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 31,125

Range in length 220-232 μ Average length 226.0 μ

Range in diameter 15-64 μ Average diameter 43.5 μ

Schroderella Pavillard

Schroderella delicatula (Peragallo) Pavillard

Hendey, p. 141, Pl. V, Fig. 4, Pl. VII, Fig. 6, 1964

Hustedt, Pt. 1, p. 551-3, Fig. 314, 1927-30

Infrequent (5% of all samples); more common offshore; possibly confused with *Lauderia borealis* in earlier months.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																						b	c	c												
N																			d	d															
G																									c	c									
O																							a												b
H																															b		D			
P																																				
Avg/1	0			0			0			0			0			0			118			24			39			0			561			14		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,371 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 6% Inshore stations (H-P) 3%

Surface samples 6% Middepth samples 6% Bottom samples 4%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 7,289

Range in length 43-77 μ Average length 65.1 μ

Range in diameter 25-60 μ Average diameter 35.9 μ

Dactyliosolen Castracane

Dactyliosolen mediterraneus H. Peragallo

Hustedt, Pt. 1, p. 556-7, Fig. 317, 1927-30

Recorded from four samples (October, May, and June); associated epiphytic flagellates (*Solenicola setigera ?*) observed in each sample; cell length 39 to 89 μ, diameter 3 to 17 μ; identification of living specimens accomplished with high magnification phase equipment (970X).

Lauderia Cleve

Lauderia borealis Gran

Hustedt, Pt. 1, p. 549-50, Fig. 313, 1927-30

Frequently recorded at inshore stations; infrequent elsewhere.

Relatively abundant when present.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F								c a				
N							c		a			
G						c a		a	a b b	a		
O		b	c D E			c a	D D D	c	b	E E D		
H			c b c	D D	c b	D D D	D	D c	D c D	D D c		
P												
Avg/1	0	11	1,129	294	17	775	421	159	589	3,233	0	0

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

985 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 11% Inshore stations (H-P) 47%

Surface samples 21% Middepth samples 22% Bottom samples 19%

Measurements:

No. cells measured 6 Average surface area (square microns) per cell 10,145

Range in length 72-80 μ Average length 76.2 μ

Range in diameter 22-65 μ Average diameter 42.4 μ

Family: CORETHRONACEAE

Corethron Castracane

Corethron criophylum Castracane

Hendey, p. 144, Pl. VII, Fig. 4, 1964

Most frequent at inshore stations; bloomed only in summer months.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F						b b	c					
N					a	b						
G							b	b	b		c	
O					a			b b				
H	D	D d					d		d d d	b	D d	E E d
P	D D D		d					a			d d	
Avg/1	2,056	222	139	0	3	14	71	4	359	6	1,192	2,778

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

6,172 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 10% Inshore stations (H-P) 28%

Surface samples 14% Middepth samples 18% Bottom samples 12%

Measurements:

No. cells measured 20 Average surface area (square microns) per cell 1,620

Range in length 21-73 μ Average length 40.3 μ

Range in diameter 8-21 μ Average diameter 12.8 μ

Family: RHIZOSOLENIACEAE

Rhizosolenia Brightwell

Rhizosolenia fragilissima Bergon

Hustedt, Pt. 1, p. 571-2, Fig. 324, 1927-30

Sixth most important species with respect to its surface area contribution to the standing stock; frequent (27% of all samples), especially inshore (51% of samples).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F						c c		b				b
N						a						
G	E E E								a c		d	F E b
O	E	d d			a			a	c			b b
H	E E E	E					c		d	F F F	E E D	E D E
P	F F E	d d d		E E F	d c c				E d d	F E d	E	G G E
Avg/1	33,421	1,981	0	12,572	122	25	44	6	1,992	39,444	3,541	170,849

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

8,802 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 23% Inshore stations (H-P) 51%

Surface samples 32% Middepth samples 28% Bottom samples 22%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 1,136

Range in length 27-88 μ Average length 59.8 μ

Range in diameter 3-13 μ Average diameter 6.1 μ

Rhizosolenia cylindrus Cleve

Hustedt, Pt. 1, p. 572-4, Fig. 325, 1927-30

Recorded from surface and middepth samples at Station G in August and from middepth at Station N during February; Curl (1959) recorded this species from the vicinity of Padre Island, Texas; Balech (1967) observed it in plankton hauls from various regions of the Gulf. The cells we examined contained the blue-green endophyte *Richelia intracellularia* Schmidt Johs.

Rhizosolenia bergonii H. Peragallo

Hustedt, Pt. 1, p. 575-7, Fig. 327, 1927-30

Not frequent (14% of all samples); rare at offshore stations.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F												
N									a			
G							b a	b b b	b b	b	b a	b
O						a	a a			a		b
H							a	b b	D D D			
P					a	a c				D C		c D b
Avg/1	0	0	0	0	<1	10	4	17	368	135	6	19

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

322 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 22% Inshore stations (H-P) 19%

Surface samples 14% Middepth samples 19% Bottom samples 8%

Measurements:

No. cells measured 10 Average surface area (square microns) per cell 31,046

Range in length 348-570 μ Average length 467.7 μ

Range in diameter 12-35 μ Average diameter 21.1 μ

Rhizosolenia delicatula? Cleve

Hustedt, Pt. 1, p. 577, Fig. 328, 1927-30

Recorded during December and January from Station H (3 samples); probably more frequent and

abundant than the data indicate, since this species may be confused with *R. fragilissima* and *R. stolterfothii.*

Rhizosolenia stolterfothii H. Peragallo

Hustedt, Pt. 1, p. 578, Fig. 329, 1927-30

Third most important contributor to the standing crop with regard to surface area; recorded in all months except September. Observed in bloom concentrations 34 times.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F													b			d	D	D	a			b	c	c								b		
N													c	c	d		a		D	c				a			a			a	b	b			
G		d	D							d	c	c	c		c		b	c	c	c	b	b	b	a	c	d	c	b	a			a	c	b	d
O	D	D	D							c	c	D	d	d	d	a	d		b		c	c	b	b			c	b			b	b	c	b	
H	E	E	E				E	D	D							c			c		c			a	b			F	E	F	d	d	c	E	F	F
P	c	E	E				c	c		E	D	E	d	D	D	b	d	D	a		c	d	c	c	c	a	c	F	E	E		c		F	E	E

Avg/1: 13,589 | 0 | 2,285 | 3,235 | 1,061 | 676 | 449 | 228 | 145 | 28,222 | 336 | 37,060

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

2,008 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 28% Middle stations (G-O) 64% Inshore stations (H-P) 68%

Surface samples 56% Middepth samples 51% Bottom samples 53%

Measurements:

No. cells measured 40 Average surface area (square microns) per cell 4,978

Range in length 54-153 μ Average length 95.0 μ

Range in diameter 5-36 μ Average diameter 16.7 μ

Rhizosolenia robusta Norman

Hustedt, Pt. 1, p. 578-80, Fig. 330, 1930

Frequent (25% of all samples) but rarely exceeding 100 cells/liter; cells of *R. robusta* were larger in surface area than those of any other species commonly recorded.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F															a	b							a		a											
N		b									a				b					B	a										b		
G	b									b			a		a				a	b	a	b		a	a										
O				b								C	a		a	a	a	a	b	a	b	b	a	a											b
H							b			B	B		a								B	a														
P							a			a						B	a	a	a	a	a	a		B	a	a	a	a		a						

Avg/1: 39 | 2 | 3 | 67 | 3 | 9 | 13 | 10 | <1 | <1 | 3 | 3

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

69 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 14% Middle stations (G-O) 33% Inshore stations (H-P) 29%

Surface samples 36% Middepth samples 12% Bottom samples 28%

Measurements:

No. cells measured 4 Average surface area (square microns) per cell 143,323

Range in length 592-697 μ Average length 644.5 μ

Range in diameter 37-85 μ Average diameter 70.8 μ

Rhizosolenia imbricata Brightwell

Hustedt, Pt. 1, p. 580-3, Fig. 331, 1927-30

Frequent (20% of all samples) but generally fewer than 1,000 cells/liter.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F															b		b	C			a			a	C											
N													b	a							b	a														
G										C			C	b			C		b	a						a				a						
O													a							b			a	a			b			a						
H	D	b	D					b		a	a											b		a						a			C	C	D
P													a	C	b				a			a			b	a		C		b						
Avg/1	467			0			6			13			42			29			116			15			5			45			<1			80		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

141 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 14% Middle stations (G-O) 19% Inshore stations (H-P) 28%

Surface samples 17% Middepth samples 18% Bottom samples 26%

Measurements:

No. cells measured 10 Average surface area (square microns) per cell 70,819

Range in length 390-810 μ Average length 576.7 μ

Range in diameter 22-50 μ Average diameter 39.1 μ

Rhizosolenia imbricata var. *shrubsolei* (Cleve) Schroder

Hustedt, Pt. 1, p. 584, Fig. 332, 1927-30

Smaller than *R. imbricata* and calyptras more elongate; sculpturing visible only with phase equipment (970X).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F												a			a					b					b											
N										b	b	b	b	c	c			a						a										b		
G	C								b	b	b					c		a					c									b	c			
H		c	c				D	D	b								a					c							C					c	c	
P								c			D	c		c	c	a	c	c	c				c		b								b	
Avg/1	53			0			244			211			50			78			11			33			2			328			0			100		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

919 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 6% Middle stations (G-O) 25% Inshore stations (H-P) 31%

Surface samples 17% Middepth samples 18% Bottom samples 26%

Measurements:

No. cells measured 10 Average surface area (square microns) per cell 10,880

Range in length 240-562 μ Average length 385.0 μ

Range in diameter 2-18 μ Average diameter 9.0 μ

Rhizosolenia setigera Brightwell

Hustedt, Pt. 1, p. 588, Fig. 336, 1927-30

Second most important contributor to the standing stock with regard to its total surface area; recorded in every month and in 50% of all samples; frequency low at offshore stations. Occurred in bloom concentrations 40 times.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F															b			b	c	a	c	b	b	b												
N			b										b		c	a	b	b															E		b
G	b									b			c	c	b			c	c	c	c				c	c	b	b								
O	D	D		b	b					b		c				b		c	b	b	b		b	c	D	c	a	c	b	b						
H	F	F	F	F	E	E	D	D	D	b	b	c	c	a	b				b	d	c	d	c	c	D	D	D	D	c		E	D	c	E	E	E
P	F	F	F		b	D				E	E	E	c	c	c	D	c	c	b	b	D	D	c	d	E	D	D	E	D	E			D	c		D
Avg/1	66,897			15,449			682			3,618			156			339			560			379			3,053			1,784			1,711			5,857		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,946= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 19% Middle stations (G-O) 47% Inshore stations (H-P) 85%

Surface samples 53% Middepth samples 46% Bottom samples 53%

Measurements:

No. cells measured 33 Average surface area (square microns) per cell 5,138

Range in length 187-540 μ Average length 237.1 μ

Range in diameter 2-15 μ Average diameter 6.9 μ

Rhizosolenia hebetata f. *semispina* (Hensen) Gran

Hendey, p. 150, Pl. III, Fig. 5, 1964

Present in five samples in June (Stations F, N, and G) and two in January (Stations O and P); closely resembles *R. imbricata* v. *shrubsolei;* cell length approximately 385 μ, diameter 6 to 15 μ; one specimen measured 34 μ in diameter.

Rhizosolenia calcar avis Schultze

Hustedt, Pt. 1, p. 592-4, Fig. 339, 1927-30

Recorded frequently (32% of all samples) and in all months of the study.

Observed in bloom concentrations 23 times.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																b		a	a	a	b		a									a					
N										a		a	b			a			a												b					
G										b					C						a				a			b	a	a	b	a	a	b	b	b
O							b						C	b	b				a			a						b						b		
H	C	C	C	D	D	D	C		C							C	a	b													b	b	C	D	E	D
P				b		b	C	C				b	b		C				a	a		a	a	a	a			D	D	D				C	C	
Avg/1	39			478			53			10			36			42			6			<1			<1			375			22			1,440		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

122 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 18% Middle stations (G-O) 29% Inshore stations (H-P) 49%

Surface samples 42% Middepth samples 26% Bottom samples 28%

Measurements:

No. cells measured 12 Average surface area (square microns) per cell 81,533

Range in length 390-840 μ Average length 587.5 μ

Range in diameter 18-100 μ Average diameter 44.2 μ

Rhizosolenia alata Brightwell

Hustedt, Pt. 1, p. 600-4, Fig. 345-6, 1927-30

Hendey, p. 146-7, Pl. II, Fig. 2-4, 1964

Saunders, p. 1, Fig. 1-4, 1967

Most important diatom encountered with regard to its total cell surface area; both frequent and abundant, occurring in 60% of all samples. Curl (1959) stated "This species is the most important diatom in Apalachee Bay. . ." Observed in bloom concentrations 48 times; auxospores were observed during October at Station P. Three forms, *R. alata* f. *alata* Hendey, *R. alata* f. *gracillima* (Cleve) Gran, and *R. alata* f. *indica* (Peragallo) Gran were frequently recorded and are combined in the table below.

OCCURRENCE BY MONTH AND DEPTH

| | | 1965 | | |

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F												b
N											c E	d
G												
O							d					
H							e e	c d c	a		b	
P			d d d					d c			F F	
Avg/1	0	0	428	0	0	0	1,847	822	<1	0	56,288	149

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

49,261= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 6% Middle stations (G-O) 1% Inshore stations (H-P) 19%

Surface samples 6% Middepth samples 6% Bottom samples 15%

Measurements:

No. cells measured 5 Average surface area (square microns) per cell 203

Range in length 5-13 μ Average length 7.9 μ

Range in diameter 2-14 μ Average diameter 8.2 μ

Rhaphoneis amphiceros Ehrenberg

Hustedt, Pt. 2, p. 174-6, Fig. 680, 1931

Observed only in permanent slides.

Asterionella Hassall

Asterionella japonica Cleve & Moller

Hendey, p. 158, Pl. XXI, Fig. 1, 1964

An important pennate species; frequent and abundant at inshore stations; recorded in bloom concentrations 16 times.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F	d											
N												
G									b d c			
O				c					c			
H	F F E	F E e	c	c	d		E E d	c d c	E E e		d b	d d E
P	E F F		c c d	E e e	d d E	b e d	d	E e d	d d		e d	d d d
Avg/1	51,900	19,628	485	6,922	1,851	789	3,578	2,787	9,799	0	1,468	2,589

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

19,157= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 7% Inshore stations (H-P) 68%

Surface samples 12% Middepth samples 26% Bottom samples 28%

Measurements:

No. cells measured 9 Average surface area (square microns) per cell 522

Range in length 52-102 μ Average length 69.3 μ

Range in diameter *6-12 μ Average diameter 9.9 μ

*cell base

Asterionella notata Grunow [Pl. 3, Fig. 14-15]

Hustedt, Pt. 2, p. 254, Fig. 733, 1932

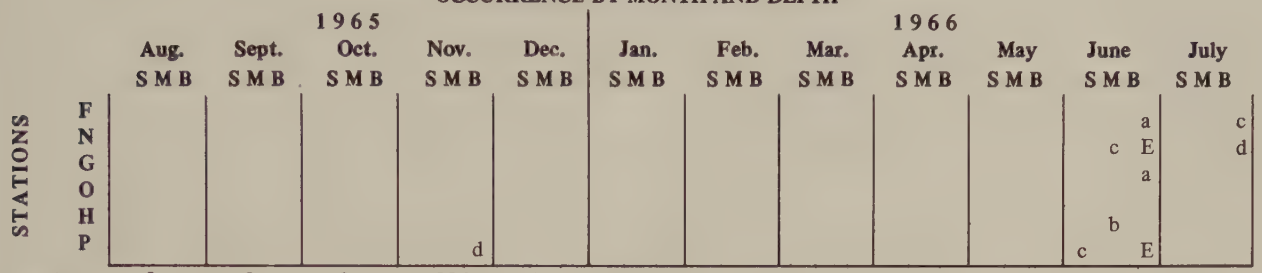
Infrequent; recorded only from five samples (November through February) at offshore and middle stations; cell length 115 μ.

Cymatosira belgica Grunow [Pl. 8, Fig. 39, 41]

Hustedt, Pt. 2, p. 127-8, Fig. 649, 1931

Recorded from 5% of all samples (40% of June samples).

OCCURRENCE BY MONTH AND DEPTH



a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

18,281= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 7% Middle stations (G-O) 1% Inshore stations (H-P) 6%

Surface samples 1% Middepth samples 3% Bottom samples 10%

Measurements:

No. cells measured 4 Average surface area (square microns) per cell 547

Range in length 7-8 μ Average length 7.6 μ

Range in diameter 12-59 μ Average diameter 36.0 μ

Striatella Agardh

Striatella unipunctata (Lyngbye) Agardh

Hendey, p. 161-2, Pl. XXVI, Fig. 17-18, 1964

Recorded only once (Station N, February, middepth).

Synedra Ehrenberg

Synedra spp.

Infrequent, observed only twice (September and November); not common in permanent slides.

Thalassiothrix Cleve & Grunow

Thalassiothrix mediterranea Pavillard

Hustedt, Pt. 2, p. 248-50, Fig. 728, 1932

Cupp, p. 185-6, Fig. 136, 1943

Infrequent (7% of all samples), seldom abundant. All specimens examined were *T. mediterranea* v. *pacifica* Cupp.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F												
N					d c							c
G			b									
O		b		d								
H		E	b d	d						D		E
P			E D D		b							
Avg/1	0	1,117	1,389	222	128	0	0	0	0	222	0	850

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

3,131 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 0% Middle stations (G-O) 8% Inshore stations (H-P) 14%

Surface samples 12% Middepth samples 4% Bottom samples 6%

Measurements:

No. cells measured 2 Average surface area (square microns) per cell 3,193

Range in length 318-360 μ Average length 339.0 μ

Range in diameter 2.6-3.4 μ Average diameter 3.0 μ

Thalassiothrix frauenfeldii Grunow

Hustedt, Pt. 2, p. 247-8, Fig. 727, 1932

Recorded from one sample in February (Station N), three in August (Station G), and one in April (Station H); cell length 185 μ.

Thalassionema (Grunow) Hustedt

Thalassionema nitzschioides Hustedt

Hendey, p. 165, 1964

Hustedt, Pt. 2, p. 244-6, Fig. 725, 1932

Frequent (22% of all samples); observed primarily from inshore stations; recorded in bloom concentrations 15 times; important among pennate species in regard to its contribution to the standing stock.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F					b		c					
N					b						a	
G					b		b c		d b			
O						b						
H	E	F d E	d b		c e	a a	d d d				F F e	E d F
P	E E E		e E d	d d E	b c	c c c				a	d E F	E
Avg/1	9,778	12,056	3,979	1,483	781	78	953	0	708	<1	28,820	15,722

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

17,094 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 6% Middle stations (G-O) 8% Inshore stations (H-P) 53%

Surface samples 25% Middepth samples 19% Bottom samples 22%

Measurements:

No. cells measured 22 Average surface area (square microns) per cell 585

Range in length 12-139 μ Average length 42.4 μ

Range in diameter 3-7 μ Average diameter 4.4 μ

Plagiogramma Greville
Plagiogramma sp.
Frustules were occasionally observed in permanent slides.
Licmophora Agardh
Licmophora abbreviata Agardh
Hustedt, Pt. 2, p. 66-8, Fig. 590, 1931
Present in samples from December, January, April, and May; length 124 μ.
Licmosphenia Mereschkowsky
Licmosphenia clevei? Mereschkowsky
Hustedt, Pt. 2, p. 37, Fig. 621, 1931
Present at Station P in April and Station N in May; length 156 to 172 μ; transapical striae 13 in 10 μ at cell base, 14 in 10 μ near center, and 17 in 10 μ at apex of cell.
Climacosphenia Ehrenberg
Climacosphenia moniligera Ehrenberg
Hustedt, Pt. 2, p. 89-91, Fig. 625, 1931
Recorded only during November (Station P) and December (Station G).
Grammatophora Ehrenberg
Grammatophora marina (Lyngbye) Kützing [Pl. 10, Fig. 52]
Hustedt, Pt. 2, p. 43-4, Fig. 569-72, 1931
Observed only in permanent slides.
Rhabdonema Kützing
Rhabdonema adriaticum Kützing
Hustedt, Pt. 2, p. 23-5, Fig. 552, 1931
Observed once during December (Station P, surface).
Suborder: Achnanthineae
Family: ACHNANTHACEAE
Achnanthes Bory
Achnanthes manifera Brun
Hustedt, p. 18, Pl. 6, Fig. 1-8, 1955
Frequent in permanent slides; length 16 to 31 μ, breadth 6 to 11 μ.
Achnanthes longipes Agardh
Hustedt, Pt. 2, p. 427-8, Fig. 878, 1933
Present in permanent slides (Stations F/N).
Cocconeis Ehrenberg
Cocconeis disculoides Hustedt [Pl. 11, Fig. 61]
Hustedt, p. 17, Pl. 5, Fig. 8-11; Pl. 7, Fig. 8, 1955
Observed in numerous permanent slides; not enumerated from live samples.
Cocconeis scutellum Ehrenberg
Hustedt, Pt. 2, p. 337-9, Fig. 390-2, 1933
Present only in permanent slides.
Suborder: Naviculineae
Family: NAVICULACEAE
Navicula Bory
Section Fusiformes
Navicula gigantea? Hustedt
Hustedt, Pt. 3, p. 40, Fig. 1194, 1961
Hustedt (1961) described this species from the south China Sea; our specimens agree in nearly every respect with his description. Living and permanent slide specimens were examined; 18 to 20 transapical and 26 to 28 longitudinal striations were observed in our specimens; *N. gigantea ?* was

recorded from approximately 7% of all samples, but July was the only month in which it became numerically important.

The following data may include smaller fusiform species (such as *N. ostrearia)* since the lower ranges of our measurements were much below the limits given by Hustedt (1961).

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F							a					
N			D									
G		c	b									b C
O				b	b b					a	b a	
H											D	
P			b									E
Avg/1	0	11	146	2	8	0	<1	0	0	<1	281	1,426

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

541 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 7% Inshore stations (H-P) 12%

Surface samples 7% Middepth samples 7% Bottom samples 7%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 18,843

Range in length 144-442 μ Average length 279.0 μ

Range in diameter 18-52 μ Average diameter 33.1 μ

Navicula quarnerensoides? Hustedt [Pl. 14, Fig. 108]

Hustedt, Pt. 3, p. 49-52, Fig. 1203, 1961

Frustules observed in permanent slides from Stations H and P during July; cell length 93 to 117 μ, diameter 10 to 12 μ; longitudinal striae 18 per 10 μ, transapical striae approximately 28 to 30 per 10 μ; our specimens conform closely to Hustedt's description.

Navicula wawrikae Hustedt [Pl. 7, Fig. 35; Pl. 16, Fig. 119]

Hustedt, Pt. 3, p. 52-53, Fig. 1204, 1961

Previously known only from the Gulf of Naples (Hustedt, 1961) and from Mauritius (Sournia, 1965); planktonic and motile in our samples; an important contributor to the standing stock; permanent slide specimens possessed 21 or 22 transapical striae per 10 μ; our specimens conformed to the original description in all particulars.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S	Aug. M	Aug. B	Sept. S	Sept. M	Sept. B	Oct. S	Oct. M	Oct. B	Nov. S	Nov. M	Nov. B	Dec. S	Dec. M	Dec. B	1966 Jan. S	Jan. M	Jan. B	Feb. S	Feb. M	Feb. B	Mar. S	Mar. M	Mar. B	Apr. S	Apr. M	Apr. B	May S	May M	May B	June S	June M	June B	July S	July M	July B
	F													a									b			b	d									
	N		c																				b			a										
	G	c	c						b			b		c									b	b	b	c	c		a				b			c	
	O	D	D	D											c		b			b					b		b	b	c	b	d			b			b	
	H				D	D																					D	D			D	D	D	b	D	b	
	P	c	E	E	c	b					D						b						b			b	d		D			D	D	D	D	b	
Avg/1		6,924			589			3			228			20			11			1			25			464			572			1,542			865		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,997 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 10% Middle stations (G-O) 37% Inshore stations (H-P) 37%

Surface samples 34% Middepth samples 34% Bottom samples 15%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 5,007

Range in length 381-500 μ Average length 450.3 μ

Range in diameter 5-7 μ Average diameter 5.6 μ

Section Navicula

Navicula cancellata Donkin [Pl. 13, Fig. 87-89]

Hendey, p. 203, Pl. 30, Fig. 18-20, 1964

Frustules were commonly observed in permanent slides; cell length 50 to 59 μ, width 25 to 27 μ; striae 4 to 6 per 10 μ.

Navicula distans (Wm. Smith) Schmidt

Hendey, p. 203-4, Pl. XXVII, Fig. 13, 1964

Regularly observed with other pennate species in permanent slides of bottom samples.

Section Punctatae

Navicula praetexta Ehrenberg

Hendey, p. 213, Pl. XXXIII, Fig. 1, 1964

Present in permanent slides of Stations F/N samples during November and April, and at Station H during March. Cell length 52 to 97 μ, diameter 29 to 54 μ; marginal striae 7 per 10 μ.

Navicula carinifera Grunow in Schmidt [Pl. 13, Fig. 90]

Hendey, p. 208, Pl. XXXI, Fig. 11; Pl. XXXIII, Fig. 5, 1964

Present in permanent slide of Station F, bottom, during June.

Section Lyratae

Navicula lyra Ehrenberg [Pl. 13, Fig. 92]

Hendey, p. 209, Pl. XXXIII, Fig. 2, 1964

Frustules recorded in slides during June and July; length 65 to 115 μ, diameter 27 to 48 μ; striae 10 or 11 per 10 μ.

Navicula clavata Gregory [Pl. 13, Fig. 91, 92]

Hendey, p. 212, Pl. XXXV, Fig. 13, 1964

Recorded from permanent slides in November (Station F, bottom), February (Station G, bottom), April (Station O, bottom), and May (Station G, bottom). Cells 46 to 81 μ in length and 33 to 43 μ broad; marginal rows of transverse striae 10 per 10 μ; striae punctate, 14 per 10 μ.

Navicula forcipata? Greville [Pl. 13, Fig. 95]

Hustedt, p. 22, Pl. 7, Fig. 12-13, 1955

A few specimens observed in slides during November (Station F, bottom) and February (Station G, bottom); length 29 to 34 μ, diameter 15 to 18 μ; marginal striae 16 per 10 μ. The great variability of this species makes positive identification difficult.

Navicula hennedyii Wm. Smith

Hendey, p. 212, Pl. XXXIII, Fig. 14, 1964

Present during January and February in permanent slides of Stations H and O bottom samples; length 48 to 88 μ, diameter 29 to 41 μ; transverse striae 12 per 10 μ.

Navicula irrorata Greville

Hustedt, p. 24, Pl. 8, Fig. 23, 1955

Observed in permanent slides during August (Station H, middepth), February (Station G, bottom), and May (Station G, bottom); length 65 to 73 μ, width 29 μ; transverse striae 9 per 10 μ.

Stauroneis Ehrenberg

Stauroneis membranacea (Cleve) Hustedt

Hustedt, Pt. 2, p. 833-4, Fig. 1176, 1959

Recorded from 17% of all samples; infrequent at offshore stations.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F					a			b	a			
N				c		a	c c c		b b	b		c
G			b			d		c		c		
O			d			a	d			d	D D d	
H			D	b c		b d D	a a	a	d	d D c		
P	c c											
Avg/1	19	0	546	67	<1	277	151	12	75	319	692	10

$a=10^0$-10^1, $b=10^1$-10^2, $c=10^2$-10^3, $d=10^3$-10^4, $e=10^4$-10^5, $f=10^5$-10^6, $g=10^6$-10^7 cells / liter.

Capital letters indicate bloom concentrations.

2,145 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 4% Middle stations (G-O) 19% Inshore stations (H-P) 28%

Surface samples 18% Middepth samples 18% Bottom samples 14%

Measurements:

No. cells measured 3 Average surface area (square microns) per cell 4,662

Range in length 40-50 μ Average length 45.0 μ

Range in diameter 38-75 μ Average diameter 51.8 μ

Diploneis Ehrenberg

Diploneis smithii (Brebisson) Cleve

Hustedt, Pt. 2, p. 647-54, Fig. 1051-2, 1937

Frequently observed in permanent slides; 36 to 45 μ long, 10 to 16 μ broad.

Diploneis bombus Ehrenberg

Hustedt, Pt. 2, p. 704-9, Fig. 1086, 1937

Observed in permanent slides from bottom samples, June (Station N) and July (Station P).

Diploneis crabro Ehrenberg [Pl. 13, Fig. 97]

Hustedt, Pt. 2, p. 616-626, Fig. 1028-37, 1937

Observed in permanent slides in November (Station F, bottom) and February (Station G, bottom); length 44 to 96 μ.

Diploneis chersonensis (Grunow) Cleve

Hustedt, Pt. 2, p. 709-712, Fig. 1088, 1937

Observed in permanent slides of Station P samples during August and September.

Caloneis Cleve

Caloneis westii (Wm. Smith) Hendey

Observed once in permanent slides (Station N, July, bottom).

Pinnularia Ehrenberg

Pinnularia ambigua Cleve [Pl. 12, Fig. 84]

Hendey, p. 233, Pl. XXXIV, Fig. 5-8, 1964

Present in permanent slides from May through July; length 31 to 84 μ, asymmetrical form of Hendey (1964).

Trachyneis Cleve

Trachyneis aspera (Ehrenberg) Cleve [Pl. 13, Fig. 85-86]

Hendey, p. 236-7, Pl. XXIX, Fig. 11-12, 1964

Observed in permanent slides of bottom samples from various stations during August, November, February, March, May, June, and July; length 61 to 104 μ, breadth 23 μ.

Mastogloia Thwaites

Mastogloia rostrata (Wallich) Hustedt

Hustedt, Pt. 2, p. 572, Fig. 1007, 1933

Previously reported only from the Indian Ocean; specimens were present in a permanent slide from May (Station F, bottom); cell length 88 μ, approximately 30 striae per 10 μ. Living specimens have been observed subsequent to the completion of this study.

Mastogloia spp.

Several unidentified species were noted in permanent slides during August (Station F, bottom) and May (Stations G and O, bottom).

Pleurosigma Wm. Smith

Pleurosigma spp.

Members of this genus were relatively important in their total cell surface area. A small percentage of this total was composed of *Gyrosigma* spp. since the two genera could not always be separated in live material. Seven species of *Pleurosigma* were identified from permanent slides and a discussion of these follows the table below. These species probably comprised the bulk of individuals within the enumerated *Pleurosigma* spp.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F			c						b			b			b	b		a	b					b	b		c									
N									a				b	b	b			a			c														b
G	b								c				D		c	b		a			b								a			a			
O			d			b									b			a			b			b			a					b			
H			b			b	D	d	d					a	c			b			c	c	c	c		a	d			d	a			D		d
P								D	d	c		c	a	b	c	b	c				b		a	b	a	c	c	c		b			D	c	E
Avg/1	208			7			1,233			31			201			60			27			71			219			472			3			4,481		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

1,241 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 24% Middle stations (G-O) 24% Inshore stations (H-P) 54%

Surface samples 18% Middepth samples 22% Bottom samples 61%

Measurements:

No. cells measured 10 Average surface area (square microns) per cell 8,052

Range in length 92-457 μ Average length 201.3 μ

Range in diameter 15-32 μ Average diameter 20.0 μ

Pleurosigma rostratum Hustedt [Pl. 12, Fig. 80]

Hustedt, p. 35, Pl. 12, Fig. 4, 1955

Previously known only from the type locality, Beaufort, North Carolina; present in permanent slides of bottom samples from Station P (April and May); cell length 71 to 90 μ, breadth 16 to 17 μ.

Pleurosigma naviculaceum Brebisson f. *minutum* Cleve

Giffen, p. 283, Fig. 112-3, 1966

Observed only from permanent slides in February (Station G, bottom), April (Stations F and P, bottom), and June (Station N, bottom); length 40 to 64 μ, diameter 11 to 13 μ; oblique and transverse striae 18 per 10 μ.

Pleurosigma reticulatum (Norman) Hustedt

Hustedt, p. 36, Pl. 12, Fig. 2, 1955

Present only in permanent slides during May (Station H, bottom) and June (Station N, middepth); length 237 to 246 μ, transverse striae 8 or 9 per 10 μ, oblique striae 13 per 10 μ.

Pleurosigma angulatum (Quekett) Wm. Smith

Hendey, p. 245-6, Pl. XXXV, Fig. 1-3; Pl. XLI, Fig. 6, 1964

Present in permanent slides from Station H (May and June), Station O (May), and Station P (July); length 107 to 149 μ, diameter 15 to 27 μ; oblique and transverse striae crossing at an angle of 60°; striae equidistant 18 to 20 per 10 μ.

Pleurosigma formosum Wm. Smith [Pl. 12, Fig. 78]

Hendey, p. 242, 1964

Recorded from permanent slides in November (Station F, bottom) and January (Station O, bottom); length 246 to 476 μ.

Pleurosigma strigosum Wm. Smith [Pl. 12, Fig. 83]

Hendey, p. 246, Pl. XXXVI, Fig. 7, 1964

Occurred in August (Station O), October (Station P), May and June (Station H), and July (Station P); the most frequent and abundant species of *Pleurosigma* in permanent slides; length 145 to 190 μ, breadth 18 to 23 μ; transverse and oblique striae 18 to 22 per 10 μ. Several specimens of the variety *P. strigosum* v. *incisum* Hagelstein were recorded from permanent slides (October, Station P). Length 159 μ, breadth 19 μ.

Pleurosigma reversum Gregory

van Heurck, p. 256, Pl. 28, Fig. 797, 1896

Valves rostrate, spatulate; pattern of striations visible with phase equipment (970X); enumerated only during February (Station N, bottom); length 123 to 205 μ, breadth 11 μ; longitudinal striations approximately 24 per 10 μ, transverse striations in excess of 30 in 10 μ.

Gyrosigma Hassall

Gyrosigma balticum (Ehrenberg) Cleve [Pl. 12, Fig. 79]

Hendey, p. 248, Pl. XXXV, Fig. 9, 1964

Live specimens observed from bottom samples in July (Station F), September and June (Station N), and April (Station P).

Gyrosigma tenuissimum? (Wm. Smith) Cleve

Hendey, p. 249, 1964

van Heurck, p. 248, Pl. 28, Fig. 798, 1896

Abundant in permanent slides during August at Stations F and O (bottom); length 52 to 86 μ, breadth 4 to 8 μ; transverse striae 18 to 22 per 10 μ, longitudinal striae not discernible.

Gyrosigma diminutum v. *constricta* Grunow

Peragallo, p. 170, Pl. XXIV, Fig. 26, 1897-1908

Observed only in permanent slides of bottom samples during September (Station F) and February (Stations G and O); valves slightly sigmoid, line of flexure slightly knobbed near cell ends; raphe and longitudinal striae recurved at valve center; central area set obliquely to the long axis of the cell, elongate and irregular in shape; cell length 81 to 87 μ, breadth 10-11 μ; longitudinal and transverse striae equidistant, 20 or 21 per 10 μ.

Amphiprora Ehrenberg

Amphiprora gigantea v. *sulcata* (O'Meara) Cleve

Cupp, p. 198, Fig. 151, 1943

Recorded from bottom samples in April (Station H) and July (Station N).

Amphiprora sp. [Pl. 7, Fig. 32-33; Pl. 16, Fig. 115]

Cells large, rectangular in outline, bound together in chains of as many as 30 cells by interconnection of marginal undulate keels; chloroplast a single body with indented margins; cell length 47 to 102 μ, diameter 24 to 33 μ; frustular markings not detectable in our specimens; relatively frequent at offshore stations during June; also recorded from Station G in December.

Amphiprora spp. [Pl. 12, Fig. 73]

Other diatoms apparently of the genus *Amphiprora* were encountered occasionally in samples. Most were recorded from December through February. Positive species identifications were not made.

Tropidoneis Cleve

Tropidoneis lepidoptera (Gregory) Cleve [Pl. 6, Fig. 27; Pl. 12, Fig. 76-77]

Cupp, p. 197, Fig. 149, 1943

Hendey, p. 256, Pl. XXXVI, Fig. 2, 4, 1964

Peragallo, p. 188, Pl. XXXIX, Fig. 3-7, 1897-1908

Referred to as *Amphiprora* "B" or *Amphiprora* sp. in previous diatom studies at this laboratory. Frustules delicate, normally not able to withstand acid boiling or drying; living cells occurring singly or as "stellate" clusters of 10 or more cells; the cells of these clusters are motile and readily separate when exposed to intense illumination; transverse striae 19-21 per 10 μ.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S M B	Sept. S M B	Oct. S M B	Nov. S M B	Dec. S M B	1966 Jan. S M B	Feb. S M B	Mar. S M B	Apr. S M B	May S M B	June S M B	July S M B
F						b						
N							c					
G								b				
O					c							
H						b	b	b d c	b			d
P				E d d	b c E	E	d c E	d E d	E d		c	
Avg/1	0	0	0	1,404	917	683	1,649	1,242	922	0	21	228

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

7,102 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 1% Middle stations (G-O) 3% Inshore stations (H-P) 37%

Surface samples 12% Middepth samples 14% Bottom samples 15%

Measurements:

No. cells measured 7 Average surface area (square microns) per cell 1,408

Range in length 44-115 μ Average length 68.7 μ

Range in diameter 8-12 μ Average diameter 10.2 μ

Family: AURICULACEAE

Auricula Castracane

Auricula complexa (Gregory) Cleve

Hendey, p. 259, Pl. XXXVIII, Fig. 15, 1964

Observed in permanent slides from a bottom sample (Station N) in June; girdle complex, composed of numerous divisions; striae transverse, 19 to 22 per 10 μ; marginal punctae present on dorsal edge of cell, approximately 10 per 10 μ; cell length 57 to 61 μ, breadth 18 to 25 μ; apparently the first record of this genus from the Gulf of Mexico.

**Thalassiophysa* Conger

Thalassiophysa rhipidis Conger

Conger, 1954b

Only one specimen observed during the study (June, Station N, bottom); observed twice in this area

since the completion of the study. These records probably represent the first recordings of this species in Gulf waters since Conger's description.

*Conger (1954) noted the close similarity of the genera *Thalassiophysa* and *Auricula*; however, he did not place *Thalassiophysa* in a family. We have therefore placed this genus in the family Auriculaceae.

Family: CYMBELLACEAE

Amphora Ehrenberg

Amphora marina H. van Heurck [Pl. 11, Fig. 66-67]

Peragallo, p. 200, Pl. XLIV, Fig. 15-17, 1897-1908

Recorded in permanent slides of bottom samples from Stations F, O, and H during November; transverse striae 14 per 10 μ; length 31 to 61 μ, breadth 19 to 23μ.

Amphora ocellata Donkin

Hendey, p. 268, Pl. XXXVIII, Fig. 13-14, 1964

Recorded from permanent slides during July (Station P, bottom). Cell length 52-65 μ; striae 18 to 20 per 10 μ.

Amphora arenaria Donkin

Hendey, p. 268, Pl. XXXVIII, Fig. 1-4, 1964

Present in permanent slides of bottom material in May (Station H) and July (Station P); length 97 to 111 μ; striae on dorsal surface 20 to 22 per 10 μ, on ventral surface 24 to 28 per 10 μ.

Amphora alata Peragallo

Peragallo, p. 205, Pl. XLIII, Fig. 4-5, 1897-1908

van Heurck, p. 131, Pl. 24, Fig. 677, 1896

Present in permanent slides in June (Station N, bottom); cell length 56 μ, breadth 28 μ.

Amphora granulata Gregory

Hustedt, p. 40, Pl. 14, Fig. 8-10, 26-27, 1955

Noted in permanent slides from Stations F/N (bottom, March through June), and Station O (bottom, January and February); length 52 to 67 μ, breadth 21 to 25 μ.

Amphora spectabilis Gregory [Pl. 14, Fig. 109]

Hendey, p. 268, Pl XXXVIII, Fig. 8-9, 1964

Specimen present in permanent slide (Station F, bottom, April); length 43 μ, breadth 23 μ; transapical striae on ventral side 15 per 10 μ.

Amphora obtusa Gregory [Pl. 11, Fig. 63]

van Heurck, p. 137, Pl. 24, Fig. 688

Wood, p. 245, Pl. 2, Fig. 35a, b, 1963

Recorded from permanent slides during January (Station O, bottom), February (Stations P and G, bottom), May (Station O, bottom), and June (Station N, middepth and bottom); length 83 to 133 μ, breadth 26 to 52 μ; transverse striae 18 per 10 μ.

Amphora egregia v. *interrupta* Peragallo [Pl. 11, Fig. 65]

Peragallo, p. 209, Pl. XLVI, Fig. 6-7, 11, 1897-1908

Recorded in permanent slides of middepth and bottom samples from November through June (Stations F/N, G, and H); length 52 to 115 μ, breadth 20 to 68 μ.

Amphora bigibba Grunow [Pl. 11, Fig. 72]

Hustedt, p. 40, Pl. 14, Fig. 19-25, 1955

Observed in permanent slides during February (Station G, bottom), May (Stations O and F, bottom), and June (Station N, bottom); cell length 33 to 55 μ.

Amphora decussata Grunow [Pl. 2, Fig. 6; Pl. 11, Fig. 62]

Hendey, p. 266, Pl. XXXVII, Fig. 9, 1964

Enumerated only once and then apparently in bloom concentrations (Station H, bottom, May); the abundance of this rather large diatom was exceptional (14,000 cells/liter); cell length 162 μ, breadth 54 μ.

Amphora spp.

Identification of most species could not be made accurately in live counts; consequently, these species were grouped under *Amphora* spp. and are enumerated below. Infrequent (5% of all samples); not abundant.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F			c									a			b																					
N			b																																	b
G															c																					
O																																				
H						b																						a								
P	b						b						b																							
Avg/1	29			6			6			<1			29			0			0			0			0			<1			0			3		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

_____ = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) _____ Middle stations (G-O) _____ Inshore stations (H-P) _____

Surface samples _____ Middepth samples _____ Bottom samples _____

Measurements:

No. cells measured _____ Average surface area (square microns) per cell _____

Range in length _____ Average length _____

Range in diameter _____ Average diameter _____

Family: BACILLARIACEAE

Bacillaria Gmelin

Bacillaria paradoxa Gmelin

Hendey, p. 274, Pl. XXI, Fig. 5, 1964

Hustedt, p. 43, 1955

Most common in bottom samples, often associated with bottom detritus.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F																									D											
N																			d												b	c		
G																																D		
O															E				c			c	c	b				d				b		
H																																				
P					D		d	d	D	a	c																		d			c	c		
Avg/1	0			278			1,981			39			672			0			100			74			278			283			338			0		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

4,288 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 6% Middle stations (G-O) 1% Inshore stations (H-P) 22%

Surface samples 4% Middepth samples 7% Bottom samples 18%

Measurements:

No. cells measured 4% Average surface area (square microns) per cell 2,332

Range in length 93-117 μ Average length 106 μ

Range in diameter 6-9 μ Average diameter 7 μ

Nitzschia Hassall

Nitzschia panduriformis Gregory [Pl. 14, Fig. 101]

Hendey, p. 279, 1964

Wood, p. 274, Pl. 10, Fig. 202a, b, 1963

Identified from permanent slides during February and May (Station G, bottom); length 64-70 μ, breadth 27-31 μ; keel punctae 6.

Nitzschia constricta (Gregory) Grunow [Pl. 14, Fig. 102-3]

Peragallo, p. 270, Pl. LXX, Fig. 8-10, 1897-1908

Observed only in permanent slides during August (Station P, bottom), November (Station F, bottom), and May (Station O, bottom); length 21 to 39 μ, breadth 8 to 14 μ; striae 11 to 13 per 10 μ.

Nitzschia sigma (Kützing) Wm. Smith

Hendey, p. 281-2, Pl. XLII, Fig. 1, 1964

Observed in permanent slides during October (Station P, bottom), November (Station F, bottom), and May (Station H, bottom); striae 20 per 10 μ; keel punctae 4 to 8 per 10 μ; cell length 124 to 445 μ.

Nitzschia insignis Gregory

van Heurck, p. 391, Pl. 32, Fig. 875-6, 1896

Present in permanent slides from August (Station P, bottom), February (Station G, bottom), March (Station H, surface), May (Stations F/N and H, bottom), and June (Stations H, bottom and N, middepth); length 49 to 73 μ.

Niszschia pungens var. *atlantica* Cleve [Pl. 6, Fig. 30]

Cupp, p. 202, Fig. 156, 1943

Frequent and abundant; important with respect to its contribution to the standing stock; observed in bloom concentrations 23 times.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F			E			b							a		b	c	b					c					d				b		b			
N			c																c						a	a				c		d			
G	E	e					E	e	c				d	d	d		b	b	c	b	c	b		b	d	c		c			b	d	d	e		
O	E	e	e		b						c		c	b		c					a					c	d	d	d		b					
H	F	F	e	F	F	E		d	d	c	c	c	c	b		e	a	c	c						d		d	d		e	d	d	F	F	F
P	F	F	F	e	d		E	d	E	e	d		d	d	c	E		d		c		d	c		d	d		d			F	F	F	F	E	b
Avg/1	123,096			17,067			11,513			802			1,051			4,303			72			178			1,592			561			27,453			44,450		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

20,490 = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 22% Middle stations (G-O) 50% Inshore stations (H-P) 74%

Surface samples 57% Middepth samples 47% Bottom samples 42%

Measurements:

No. cells measured 11 Average surface area (square microns) per cell 488

Range in length 44-77 μ Average length 62.2 μ

Range in diameter 1.2-3.4 μ Average diameter 2.5 μ

Nitzschia longissima (Brebisson) Ralfs

Hendey, p. 283, 1964

Observed in two bottom samples (Stations F, December and O, September); length 207 to 321 μ, diameter 10 μ; keel punctae 6 per 10 μ; striae 28 per 10 μ.

Nitzschia closterium? (Ehrenberg) Wm. Smith

Hendey, p. 283, Pl. XXI, Fig. 8, 1964

This species was encountered frequently (51% of all samples) but not sufficiently abundant to be a major contributor to the standing stock.

OCCURRENCE BY MONTH AND DEPTH

STATIONS	1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
F			e			b					c	b								b	c			b	c	c	d				a	b			b
N			b						a			a	b								c	b						b		b	b	e			c
G					b		e	d	d				d		c		c				e		b		d			b			d	d	d		b	b
O		E	e	b								d		b			c				c		b					d	b	d		b	b		b	b
H	d	d	d	E	E	d	d	c	d				d	d	d		d				e	d	c	b	d	d	e		d	d	e	e	d	e	E	E
P	F	E	F		b	e	e	e	e	d		e		b	d	d	c	c	b				c	d	d	d	d	e			e	E	E	d	e	d
Avg/1	49,573			7,539			6,137			2,237			1,328			381			1,556			490			1,960			2,407			14,522			11,129		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

39,682= the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) 33% Middle stations (G-O) 43% Inshore stations (H-P) 78%

Surface samples 39% Middepth samples 49% Bottom samples 67%

Measurements:

No. cells measured 17 Average surface area (square microns) per cell 252

Range in length 50-179 μ Average length 101 μ

Range in diameter 1-6 μ Average diameter 3.5 μ

Suborder: Surirellineae

Family: SURIRELLACEAE

Surirella Turpin

Surirella gemma (Ehrenberg) Kützing

Hendey, p. 288, Pl. XL, Fig. 5; Pl. XLII, Fig. 4, 1964

Observed in permanent slides during January (Station O, bottom); length 82 μ, breadth 39 μ.

Surirella fastuosa (Ehrenberg) Kützing

Hendey, p. 288, Pl. XL, Fig. 4, 1964

Occurred in permanent slides during November (Station F, bottom), December (Station G, bottom), April (Station F, bottom), June (Stations N, middepth and bottom, and H, bottom), and July (Station H, bottom); length 37 μ, breadth 20 μ.

Campylodiscus Ehrenberg

Campylodiscus samoensis Grunow

Schmidt's Atlas, Pl. 15, 1875

Curl, p. 303, Fig. 108, 1959

Observed only in permanent slides of bottom samples in February and May (Station G) and June (Station N); diameter 31 to 41 μ.

Campylodiscus sp. [Pl. 14, Fig. 99]

Observed in a permanent slide of a bottom sample in June (Station N).

Naviculoid species [Pl. 11, Fig. 64069; Pl. 12, Fig. 75; Pl. 13, Fig. 94-96; Pl. 14, Fig. 104-5]

Diatoms enumerated from live samples but not identified to genus or species: included within this group were *Navicula, Nitzschia, Diploneis, Mastogloia, Trachyneis, Achnanthes* and perhaps other species.

OCCURRENCE BY MONTH AND DEPTH

STATIONS		1965 Aug. S	M	B	Sept. S	M	B	Oct. S	M	B	Nov. S	M	B	Dec. S	M	B	1966 Jan. S	M	B	Feb. S	M	B	Mar. S	M	B	Apr. S	M	B	May S	M	B	June S	M	B	July S	M	B
	F			e					c				c	b	b	b		b	b		a	c	c		b		d									
	N		c																			c									b	b	e		b	c
	G		c	e	b			d	d	d	b			c		c						c							b		b		d			b
	O	b	d	d	d							b			b														d				b				
	H			d		d	b						c			d				b		e	c	c	c		c	d			d	e	f	e		d	d
	P	e	e	e	c	b	d	d	d	d	d	d	d	c			c	c				d					c	b	d			d	e	e	d	b	e
Avg/1		7,833			573			1,119			791			346			31			799			56			500			947			18,040			6,132		

a=10^0-10^1, b=10^1-10^2, c=10^2-10^3, d=10^3-10^4, e=10^4-10^5, f=10^5-10^6, g=10^6-10^7 cells / liter.

Capital letters indicate bloom concentrations.

_____ = the minimum number of cells necessary to comprise a bloom.

Frequency of occurrence in:

Offshore stations (F/N) _____ Middle stations (G-O) _____ Inshore stations (H-P) _____

Surface samples _____ Middepth samples _____ Bottom samples _____

Measurements:

No. cells measured _____ Average surface area (square microns) per cell _____

Range in length _____ Average length _____

Range in diameter _____ Average diameter _____

LITERATURE CITED

BALECH, E.

1967. Microplankton of the Gulf of Mexico and the Caribbean Sea. *Texas A. M. Univ. Res. Found.*, Project 382: 1-144.

BIRNHAK, B. I., P. V. DONNELLY, and R. P. SAUNDERS

1967. Studies on *Guinardia flaccida* (Castracane) Peragallo. *Fla. Bd. Conserv. Mar. Lab.*, Leaf. Ser. Vol. I, Pt. 3, No. 3: 1-23.

BRUNEL, J.

1962. Le phytoplancton de la Baie des Chaleurs. *Minist. Chasse et Peche, Quebec*, Contrib. No 91: 1-365.

CONGER, P. S.

1954a. Present status of diatom studies in the Gulf of Mexico. *Fish. Bull. U. S.*, 89: 227-232.

CONGER, P. S.

1954b. A new genus and species of plankton diatom from the Florida straits. *Smithson. Misc. Coll., 122*(14): 1-8.

CROXTON, F. E.

1959. Elementary statistics. Dover Publications, Inc., N. Y. 376 pp.

CUPP, E. E.

1943. Marine plankton diatoms of the west coast of North America. *Bull. Scripps. Inst. Oceanogr., 5*(1): 1-238.

CURL, H., JR.

1959. The phytoplankton of Apalachee Bay and the northeastern Gulf of Mexico. *Inst. Mar. Sci., 6*: 277-320.

DAVIS, C. C.

1950. Observations of plankton taken in marine waters of Florida in 1947 and 1948. *Quart. Jour. Florida Acad. Sci., 12*(2): 67-103.

DRAGOVICH, A.

1963. Hydrology and plankton of coastal waters at Naples, Florida. *Quart. Jour. Florida Acad. Sci., 26*(1): 22-47.

FREESE, L. R.
1952. Marine diatoms of the Rockport, Texas bay area. *Tex. J. Sci., 4* (3): 331-386.
GIFFEN, M. H.
1966. Contributions to the diatom flora of South Africa. III. Diatoms of the marine littoral regions at Kidd's Beach near East London, Cape Province, South Africa. *Nova Hedwigia, 8*: 245-292.
GLENN, D. A.
1966. *Biddulphia regia* (Schultze) Ostenfeld. *Fla. Bd. Conserv. Mar. Lab.*, Leaf. Ser. Vol. I, Pt. 2, No. 2: 1-3.
HAGELSTEIN, R.
1938. Scientific survey of Porto Rico and the Virgin Islands. Botany of Porto Rico and the Virgin Islands. Diatomaceae. *N. Y. Acad. Sci., 8*(3): 313-450.
HENDEY, N. I.
1964. An introductory account of the smaller algae of British coastal waters. Part V. Bacillariophyceae (Diatoms). *Fish. Invest.*, Ser. 4: 1-317.
HEURCK, H. VAN
1896. A Treatise on the Diatomaceae. Translated by W. E. Baxter. Reprint (1962) Wheldon & Wesley, Ltd. and Verlag J. Cramer. 558 pp.
HOPKINS, T. L.
1966. The plankton of the St. Andrew Bay system, Florida. *Inst. Mar. Sci., 11*: 12-64.
HULBURT, E. M.
1963. The diversity of phytoplankton populations in oceanic, coastal, and estuarine regions. *J. Mar. Res., 21*(2): 81-93.
HUSTEDT, F.
1930. Die Kieselalgen Deutschlands, Osterreich und der Schweiz. *In* Rabenhorst's Kryptogamen-Flora, *7*(1): 1-920. 542 figs.
HUSTEDT, F.
1955. Marine littoral diatoms of Beaufort, North Carolina. *Duke Univ. Mar. Stat.*, Bull. No. 6: 1-67.
HUSTEDT, F.
1962. Die Kieselalgen Deutschland, Osterreich und der Schweiz. *In* Rabenhorst's Kryptogamen-Flora, *7*(2): 1-845. 637 figs.
HUSTEDT, F.
1964. Die Kieselalgen Deutschland, Osterreich und der Schweiz. *In* Rabenhorst's Kryptogamen-Flora, *7*(3): 1-556. 411 figs.
KING, J. E.
1950. A preliminary report on the plankton of the west coast of Florida. *Quart. Jour. Florida Acad. Sci., 12*(2): 109-137.
LEBOUR, M. V.
1930. The planktonic diatoms of northern seas. *Ray Soc. Publ.*, No. 116: 1-244.
MARSHALL, N.
1956. Chlorophyll *a* in the phytoplankton in coastal waters of the eastern Gulf of Mexico. *J. Mar. Res., 15*(1): 14-32.
PAASCHE, E.
1960. On the relationship between primary production and standing stock of phytoplankton. *J. Cons. Int. Explor. Mer., 26*(1): 33-48.
PERAGALLO, H. and M. PERAGALLO
1908. Diatomees marines de France et des districts maritimes voisins. Reprinted by A. Asher & Co., 1965, Amsterdam. 491 pp.

PRATT, D. M.
1959. The phytoplankton of Narragansett Bay. *Limnol. Oceanogr., 4*(4): 425-440.
RILEY, G. A.
1938. Plankton studies. I. A preliminary investigation of the plankton of the Tortugas region. *J. Mar. Res., 1*(4): 335-352.
RILEY, G. A.
1957. Phytoplankton of the north central Sargasso Sea, 1950-52. *Limnol. Oceanogr., 2*(3): 252-270.
SAUNDERS, R. P.
1967. *Rhizosolenia alata* Brightwell. *Fla. Bd. Conserv. Mar. Lab.,* Leaf. Ser. Vol. I, Pt. 2, No. 4: 1-7.
SAUNDERS, R. P. and C. L. WAHLQUIST
1966. Diatoms and their relationship to *Gymnodinium breve* Davis. *In* Observations of an Unusal Red Tide. A Symposium. *Fla. Bd. Conserv. Mar. Lab.,* Prof. Pap. Ser. No. 8: 16-25.
SAUNDERS, R. P., B. I. BIRNHAK, J. T. DAVIS, and C. L. WAHLQUIST
1967. Seasonal distribution of diatoms in Florida inshore waters from Tampa Bay to Caxambas Pass, 1963-64. *In* Red Tides Studies, Pinellas to Collier Counties, 1963-1966. A Symposium. *Fla. Bd. Conserv. Mar. Lab.*, Prof. Pap. Ser. No. 9: 48-78.
SIMMONS, E. G. and W. H. THOMAS
1962. Phytoplankton of the eastern Mississippi Delta. *Inst. Mar. Sci., 8*: 269-298.
SOURNIA, A.
1965. Premier inventaire du phytoplancton littoral de l'Ile Maurice. *Bull. Mus. Natl. Hist. Nat.*, Ser. 2, *37*(6): 1046-1050.
WOOD, E. J. F.
1963. A study of the diatom flora of fresh sediments of the south Texas bays and adjacent waters. *Inst. Mar. Sci., 9*: 237-310.

APPENDIX I
TEMPERATURES OF HOURGLASS SAMPLES
August 1965 through July 1966

Station	Depth	Temperature Month												Average
		A	S	O	N	D	J	F	M	A	M	J	J	
SURFACE F		29.0	30.0	27.5	17.5	22.0	21.0	17.5	19.0	19.0	23.5	26.5	27.0	23.3
SURFACE N		29.2	28.9	26.5	20.0	21.5	19.5	20.0	20.5	20.0	24.5	26.5	28.0	23.8
SURFACE G		29.5	28.4	28.0	19.0	21.0	20.8	19.0	19.0	20.0	24.5	26.5	29.0	23.7
SURFACE O		29.3	29.9	26.0	17.0	19.8	18.5	17.0	20.0	20.0	24.8	27.5	28.5	23.2
SURFACE H		30.5	31.2	29.0	15.5	19.5	20.5	15.5	20.5	21.5	26.5	27.0	30.0	23.9
SURFACE P		29.8	30.4	26.0	18.0	18.2	18.5	18.0	20.0	21.5	26.0	29.5	29.0	23.7
	Average	29.6	29.8	27.2	17.8	20.3	19.8	17.8	19.8	20.3	25.0	27.2	28.6	23.6
MIDDEPTH F	64′	28.5	30.0	27.0	17.5	22.0	21.0	17.5	18.5	19.5	22.0	24.0	26.0	22.8
MIDDEPTH N	64′	28.7	28.7	26.5	20.0	21.3	19.5	20.0	19.0	20.0	24.0	22.5	26.0	23.0
MIDDEPTH G	39′	29.5	28.6	27.5	16.0	21.0	20.1	16.0	19.0	19.5	24.5	26.5	27.5	23.0
MIDDEPTH O	39′	29.3	29.7	26.0	17.0	19.7	18.5	17.0	18.0	19.5	24.5	26.5	28.5	22.8
MIDDEPTH H	11′	30.5	31.0	29.0	14.0	19.5	20.5	14.0	20.5	21.5	26.0	27.0	29.0	23.5
MIDDEPTH P	10′	28.8	30.3	26.0	17.5	18.2	18.5	17.5	19.5	20.5	26.0	27.5	29.0	23.3
	Average	29.2	29.7	27.0	17.0	20.3	19.7	17.0	19.1	20.1	24.5	25.7	27.7	23.1
BOTTOM F	128′	24.5	27.8	25.0	17.5	22.0	20.5	17.5	18.0	18.5	20.0	22.5	23.0	21.4
BOTTOM N	128′	23.2	22.2	24.5	18.5	21.3	19.5	18.5	20.5	19.0	21.5	22.5	23.0	21.2
BOTTOM G	78′	29.8	23.0	26.5	16.0	21.0	20.5	16.0	19.5	19.5	23.5	25.5	28.0	22.4
BOTTOM O	78′	29.3	27.5	26.0	17.0	20.0	18.5	17.0	18.5	20.0	25.0	26.5	28.0	22.8
BOTTOM H	22′	30.0	30.7	29.0	14.0	19.5	19.5	14.0	20.5	21.5	26.5	27.0	29.5	23.5
BOTTOM P	20′	29.8	30.2	25.5	17.0	18.4	18.5	17.5	19.5	21.5	26.0	27.5	28.0	23.3
	Average	27.8	26.9	26.1	16.7	20.4	19.5	16.7	19.4	20.0	23.7	25.2	26.6	22.4

APPENDIX II
SALINITIES OF HOURGLASS SAMPLES
August 1965 through July 1966

Station	Depth	Salinity °/oo Month												Average
		A	S	O	N	D	J	F	M	A	M	J	J	
SURFACE F		28.8	35.4	35.9	35.8	35.9	36.1	36.1	36.0	35.5	36.3	35.7	36.1	35.3
SURFACE N		36.1	31.4	35.8	35.8	36.0	35.9	36.3	35.8	35.7	36.0	35.9	35.8	35.5
SURFACE G		32.2	36.2	35.9	35.5	35.3	35.3	35.1	35.2	34.9	35.6	35.4	35.5	35.2
SURFACE O		35.3	35.6	35.5	34.7	35.2	35.0	35.2	34.2	34.7	35.4	35.8	35.6	35.2
SURFACE H		31.5	32.7	34.5	34.8	34.8	33.8	32.9	34.0	34.7	34.5	34.2	33.6	33.8
SURFACE P		34.8	34.7	34.0	33.2	33.0	34.0	32.8	33.4	34.8	35.0	34.9	35.0	34.1
	Average	33.1	34.3	35.3	35.0	35.0	35.0	34.7	34.8	35.0	35.5	35.3	35.3	34.9
MIDDEPTH F	64′	35.6	35.7	35.7	35.6	35.9	36.1	36.1	36.2	36.1	36.3	36.0	36.1	35.9
MIDDEPTH N	64′	34.4	34.1	35.6	35.8	35.9	35.9	36.4	36.2	36.2	36.1	36.2	36.0	35.7
MIDDEPTH G	39′	32.2	36.2	33.6	35.5	35.3	35.8	35.2	35.2	35.1	35.6	35.4	35.8	35.1
MIDDEPTH O	39′	33.2	35.7	35.6	34.6	35.5	34.9	35.3	35.6	34.8	35.3	35.7	35.6	35.1
MIDDEPTH H	11′	31.1	35.5	35.1	34.9	34.9	34.5	33.2	34.0	34.7	34.8	34.4	34.8	34.3
MIDDEPTH P	10′	35.1	24.4	34.0	33.1	33.2	34.0	32.6	33.7	34.8	34.9	35.3	34.9	33.3
	Average	33.6	33.6	34.9	34.9	35.1	35.2	34.8	35.1	35.3	35.5	35.5	35.5	34.9
BOTTOM F	128′	35.9	36.2	36.2	35.8	35.9	36.0	36.1	36.2	36.3	36.2	36.1	36.3	36.1
BOTTOM N	128′	35.1	30.5	36.2	35.8	36.0	35.9	36.2	36.2	36.3	36.2	36.2	36.2	35.6
BOTTOM G	78′	36.1	36.2	34.0	35.5	35.3	35.6	35.2	35.2	36.0	35.5	35.8	35.9	35.5
BOTTOM O	78′	35.2	35.5	35.9	35.4	35.6	35.3	35.3	35.6	35.9	35.4	35.8	35.8	35.6
BOTTOM H	22′	28.7	36.0	35.2	35.2	34.9	34.7	33.2	34.0	34.9	35.2	35.0	35.2	34.3
BOTTOM P	20′	34.8	27.6	34.0	33.1	33.8	34.0	32.9	33.9	34.9	34.9	35.2	35.3	33.7
	Average	34.3	33.7	35.2	35.1	35.2	35.2	34.8	35.2	35.7	35.6	35.7	35.8	35.1

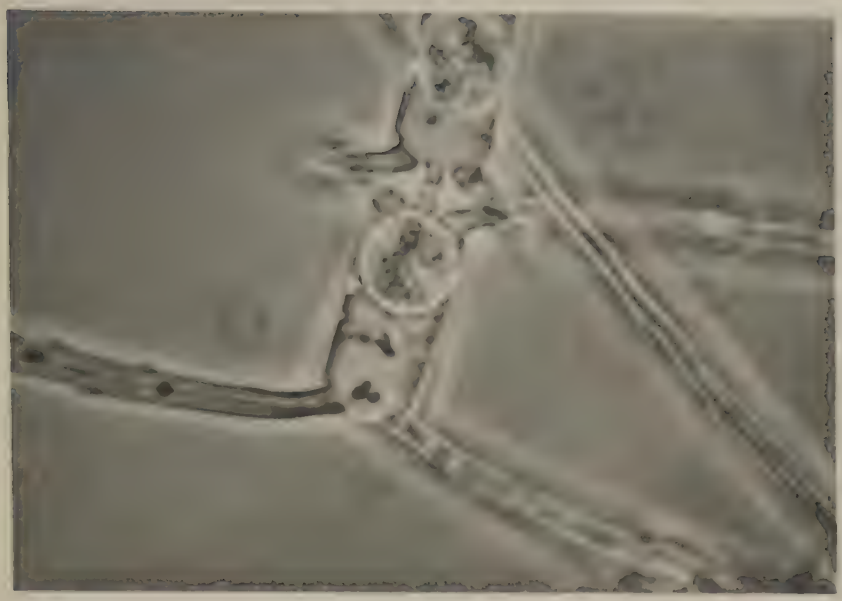
PLATE 1

Figure 1. *Chaetoceros glandazii* – phase. Diameter 15 μ.

Figure 2. *Bacteriastrum comosum* – bright field. Diameter 7 μ.

Figure 3. *Chaetoceros lauderis* – bright field. Diameter 37 μ.

Figure 4. *Chaetoceros lauderis* – bright field. Same specimen as Figure 3.



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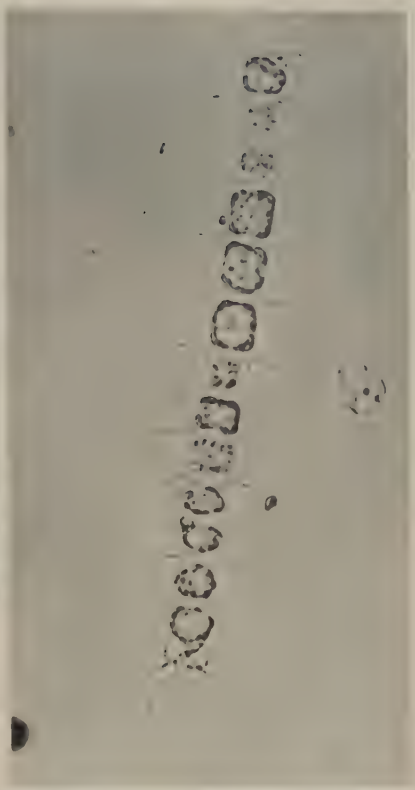

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PLATE 1

PLATE 2

Figure 5. *Chaetoceros tortissimum* – bright field. Diameter 30 μ.

Figure 6. *Amphora decussata* – bright field. Detail of specimen mounted in Hyrax. Diameter approximately 35 μ.

Figure 7. *Chaetoceros atlanticum* f. *audax* – bright field. Diameter 7 μ.

Figure 8. *Chaetoceros atlanticum* f. *audax* – bright field. Same specimen as Figure 7.

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PLATE 2

PLATE 3

Figure 9. *Chaetoceros breve* – bright field. Diameter 16 μ.

Figure 10. *Chaetoceros affine* – phase. Diameter 23 μ.

Figure 11. *Bacteriastrum hyalinum* – phase. Diameter 16 μ.

Figure 12. *Cerataulina pelagica* – dark field. No measurement taken. Single cell and developing auxospore.

Figure 13. *Chaetoceros coarctatum* – bright field. Diameter 34 μ.

Figure 14. *Asterionella notata* – bright field. Cell length 120 μ.

Figure 15. *Asterionella notata* – bright field. Same cells as Figure 14.

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PLATE 3

PLATE 4

Figure 16. *Chaetoceros laciniosum* – phase. Diameter 9 μ. Detail of end cell.

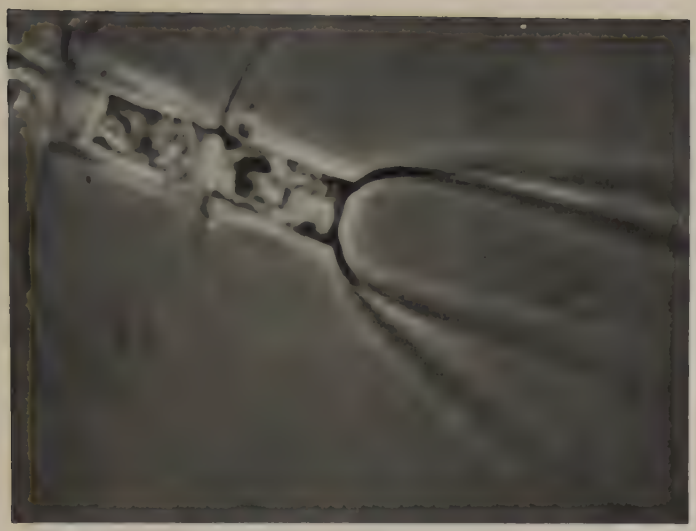
Figure 17. *Chaetoceros laciniosum* – phase. Same specimen. Detail from near center of chain of cells.

Figure 18. *Chaetoceros laciniosum* – phase. Same specimen. Entire chain of cells.

Figure 19. *Chaetoceros sociale* – bright field. A typical aggregation of cells. Colony 350 μ in diameter.

Figure 20. *Chaetoceros didymum* v. *anglica* and attached "naviculoid" species – phase. Diameter 21 μ.

Figure 21. *Chaetoceros didymum* – phase. Diameter 12 μ.



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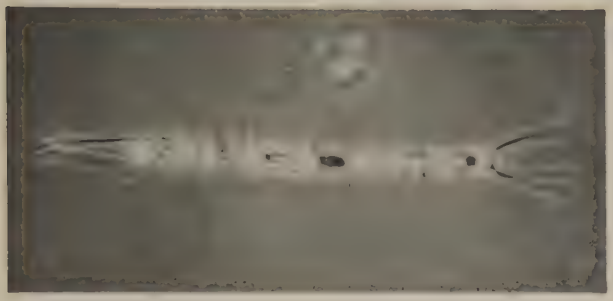

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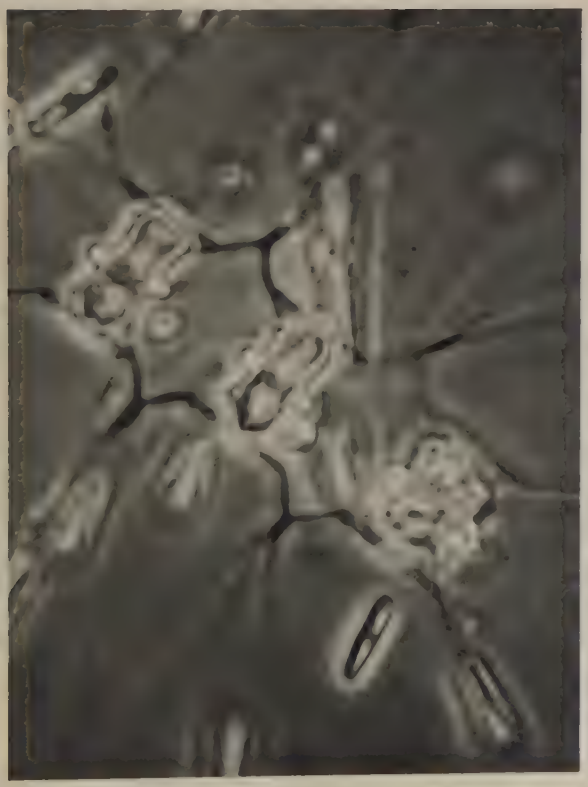

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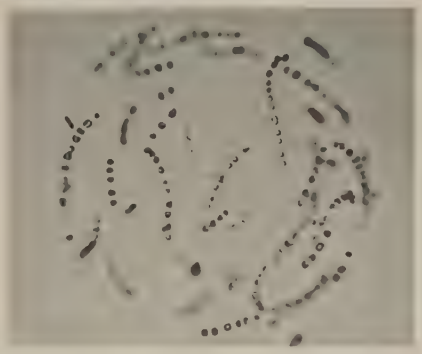

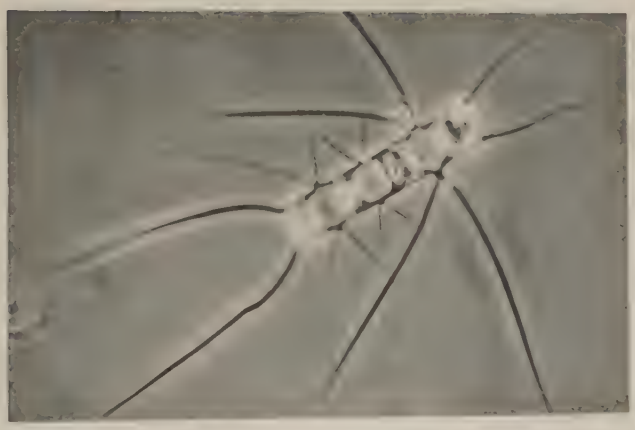

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PLATE 4

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PLATE 5

Figure 22. *Chaetoceros curvisetum* – phase. Diameter 11 μ.

Figure 23. *Rhizosolenia acuminata* – phase. Diameter 144 μ.

Figure 24. *Chaetoceros* sp. "A" – phase. Diameter 7 μ.

Figure 25. *Chaetoceros* sp. "A" – phase. Diameter 5 μ.

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PLATE 5

PLATE 6

Figure 26. *Cyclotella* sp. – bright field. Diameter 17 μ.

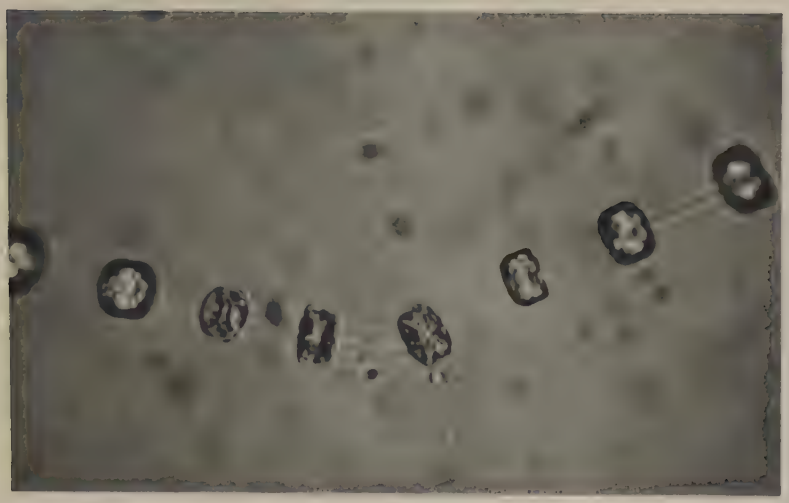
Figure 27. *Tropidoneis lepidoptera* – bright field. A typical aggregation of cells.

Figure 28. *Paralia sulcata* – bright field. Developing auxospore. No measurements taken.

Figure 29. *Thalassiosira aestivalis* – bright field. Diameter 7 μ.

Figure 30. *Nitzschia pungens* v. *atlanticum* – phase. Diameter 3 μ.

Figure 31. *Rhaphoneis surirella* – bright field. Diameter 10 to 15 μ. The chains of cells are attached to a sediment particle.



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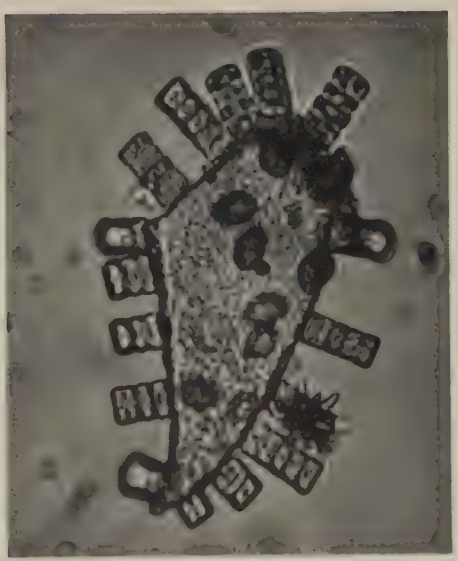

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PLATE 6

PLATE 7

Figure 32. *Amphiprora* sp. – bright field. Diameter 102 μ.

Figure 33. *Amphiprora* sp. – bright field. Entire chain of cells. Same specimen as Figure 32.

Figure 34. *Coscinodiscus centralis* – bright field. X 1,150. Detail of aerolations.

Figure 35. *Navicula wawrikae* – phase. Length 314 μ.

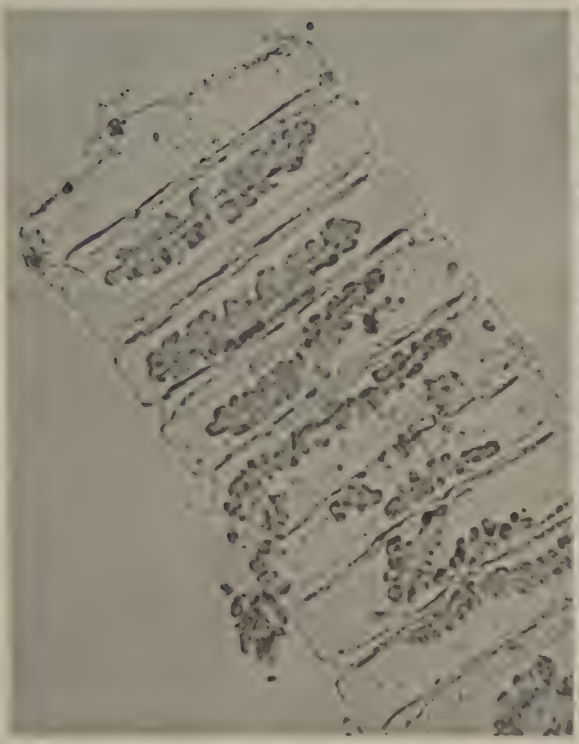
Figure 36. *Bacteriastrum delicatulum* – phase. Diameter 9 μ.

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PLATE 7

PLATE 8

Figure 37. *Cyclotella* sp. – bright field. Diameter 16 μ. Hyrax.

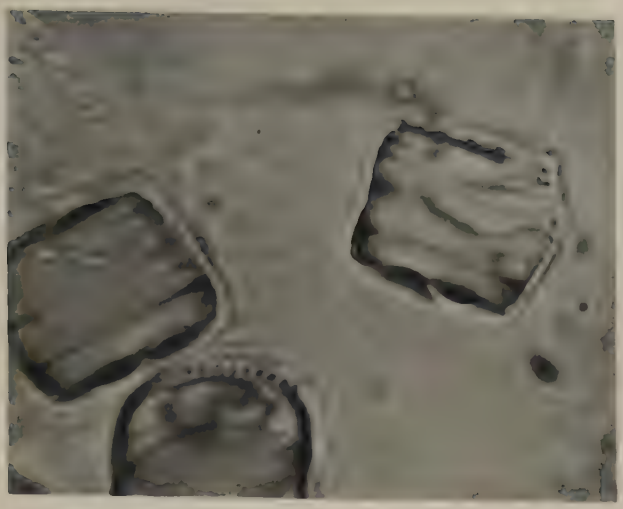
Figure 38. *Cyclotella* sp. – bright field. Diameter 16 μ. Hyrax. Pores are visible in upper specimen.

Figure 39. *Cymatosira belgica* – bright field. Diameter 44 μ.

Figure 40. *Chaetoceros radicans* – bright field. Measurement not taken.

Figure 41. *Cymatosira belgica* – bright field. Diameter 19 μ.

Figure 42. *Bellerochea malleus* f. *tetragona* – bright field. Diameter 37 μ.



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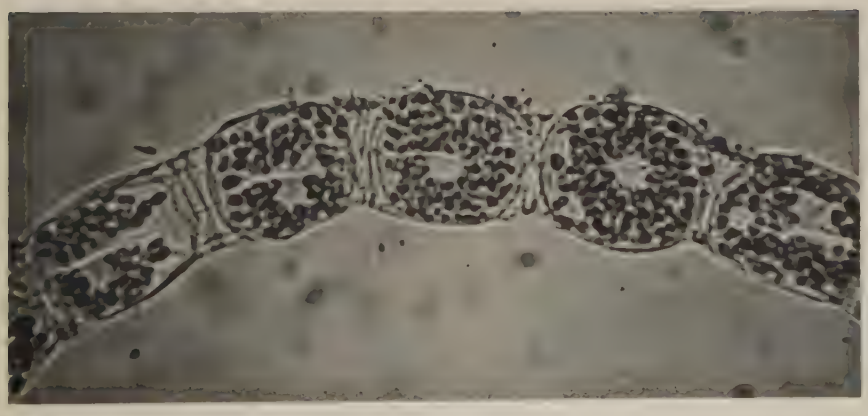

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PLATE 8

PLATE 9

Figure 43. *Podosira stelliger* – bright field. Diameter 78 μ.

Figure 44. *Coscinodiscus centralis* – bright field. Diameter 110 μ.

Figure 45. *Coscinodiscus granii* – bright field. Diameter 75 μ.

Figure 46. *Aulacodiscus argus* – bright field. Diameter 114 μ.

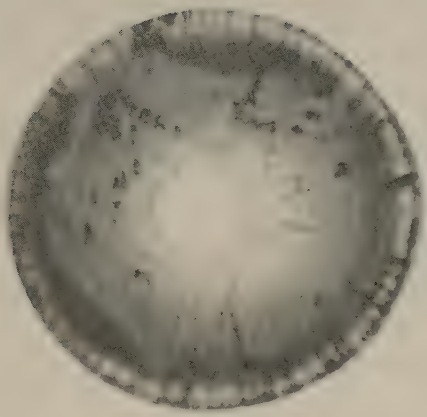
Figure 47. *Aulacodiscus argus* – dark field. Diameter 122 μ.

Figure 48. *Eupodiscus radiatus* – bright field. Diameter 112 μ.

Figure 49. *Actinoptychus undulatus* – bright field. Diameter 45 μ.

Figure 50. *Actinoptychus splendens* – bright field. Diameter 97 μ.

Figure 51. *Actinocyclus ehrenbergii* – bright field. Diameter 46 μ.



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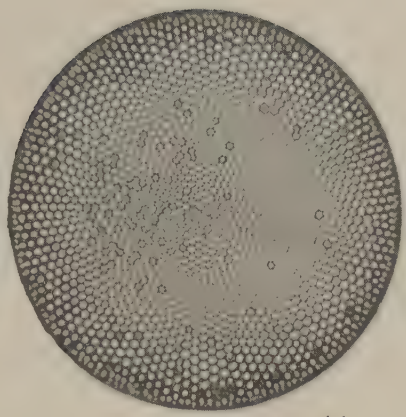

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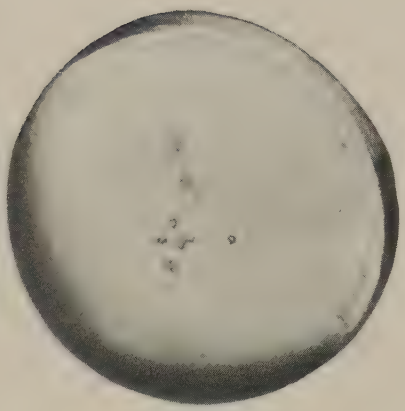

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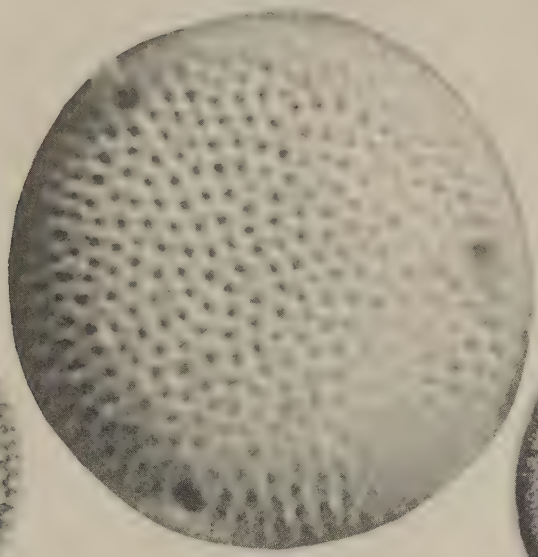

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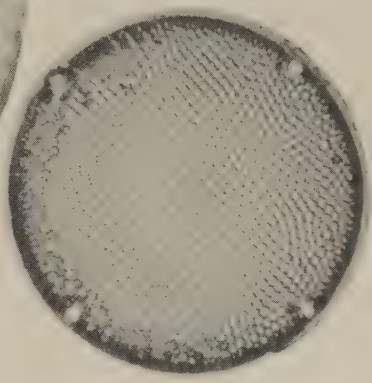

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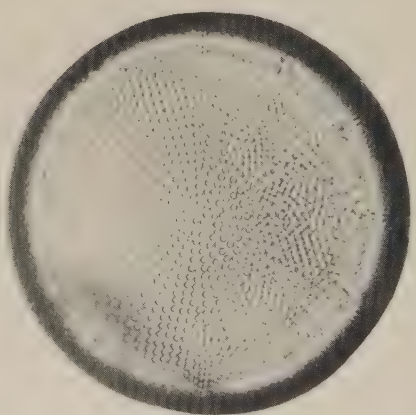


51

PLATE 9

PLATE 10

Figure 52. *Grammatophora marina* – bright field. Length 31 μ.

Figure 53. *Asteromphalus hookeri* –phase. Greatest diameter 48 μ.

Figure 54. *Triceratium favus* – bright field. Diameter 110 μ.

Figure 55. *Biddulphia alternans* – bright field. Diameter 19 μ.

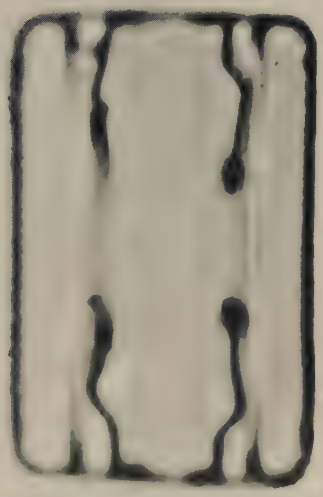
Figure 56. *Biddulphia rhombus* f. *trigona* – bright field. Diameter 195 μ.

Figure 57. *Biddulphia aurita* – bright field. Diameter 20 μ.

Figure 58. *Biddulphia rhombus* – bright field. Greatest diameter 166 μ. Living cell.

Figure 59. *Biddulphia rhombus* – bright field. Diameter 54 μ. Girdle view.

Figure 60. *Biddulphia rhombus* – bright field. Diameter 116 μ. Hyrax.



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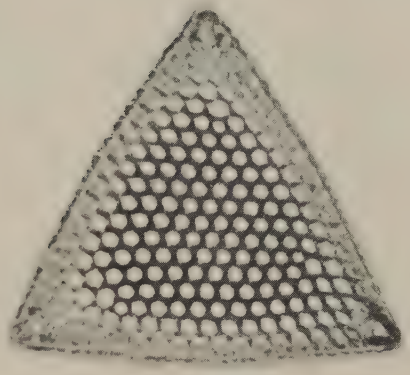

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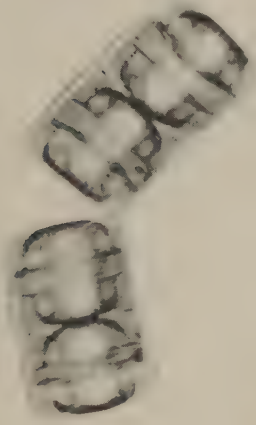

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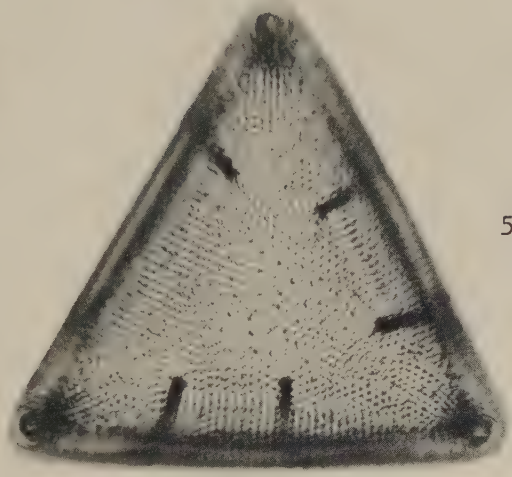

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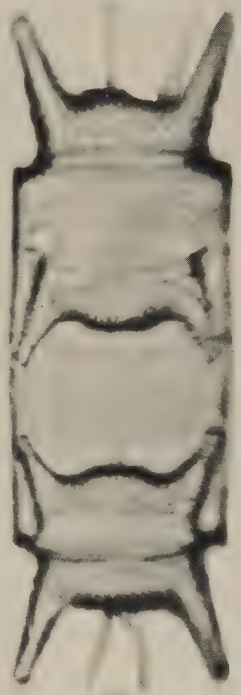

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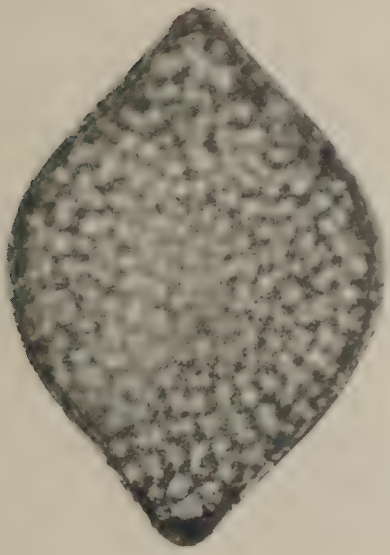

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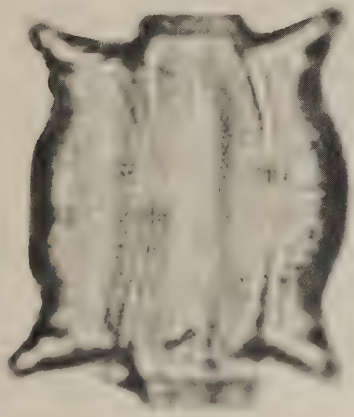

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PLATE 10

PLATE 11

Figure 61. *Cocconeis disculoides* – bright field. Length 32 μ.

Figure 62. *Amphora decussata* – bright field. Length 116 μ.

Figure 63. *Amphora obtusa* – bright field. Length 94 μ.

Figure 64. *Cocconeis* sp. ? – bright field. Length 54 μ.

Figure 65. *Amphora egregia* v. *interrupta* – bright field. Length 115 μ. Darkened area is an air pocket.

Figure 66. *Amphora marina* – bright field. Length 70 μ.

Figure 67. *Amphora marina* – bright field. Length 76 μ.

Figure 68. *Auliscus sculptus* – bright field. Diameter 43 μ.

Figure 69. *Amphora* sp. ? – bright field. Length 81 μ.

Figure 70. *Coscinodiscus radiatus* – bright field. Diameter 41 μ.

Figure 71. *Rhaponeis surirella* – bright field. Length 51 μ.

Figure 72. *Amphora bigibba* – bright field. Length 44 μ.

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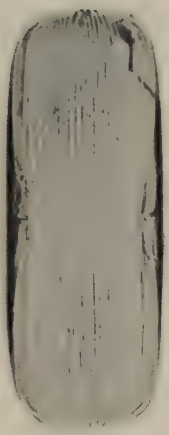

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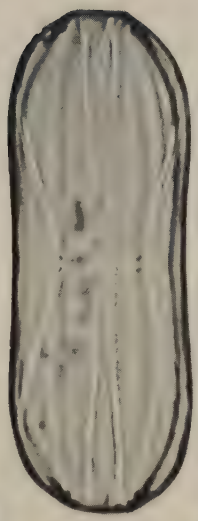

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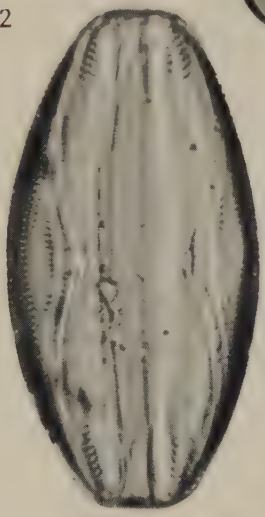

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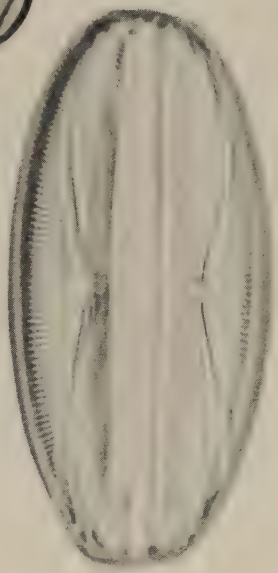

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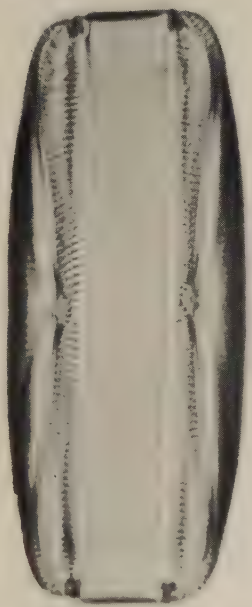

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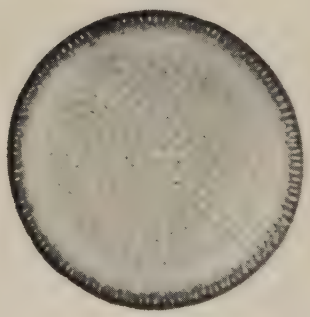

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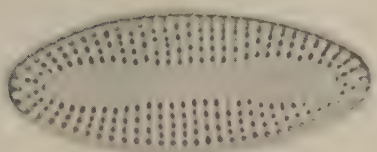

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PLATE 11

PLATE 12

Figure 73. *Amphiprora* sp. [*A. alata ?* (Ehrenberg) Kützing] – bright field. Length 255 μ.

Figure 74. Same – bright field. Length 210 μ.

Figure 75. *Diploneis* sp. ? – bright field. Length 45 μ.

Figure 76. *Tropidoneis lepidoptera* – bright field. Length 150 μ. Girdle view.

Figure 77. *Tropidoneis lepidoptera* – bright field. Length 162 μ. Valve view.

Figure 78. *Pleurosigma formosum* – bright field. Length 346 μ.

Figure 79. *Gyrosigma balticum* – bright field. Length 204 μ.

Figure 80. *Pleurosigma rostratum* – bright field. Length 79 μ.

Figure 81. *Diploneis smithii* – bright field. Length 60 μ.

Figure 82. *Diploneis smithii* – bright field. Length 65 μ.

Figure 83. *Pleurosigma strigosum* – bright field. Length 180 μ.

Figure 84. *Pinnularia ambigua* – bright field. Length 94 μ.

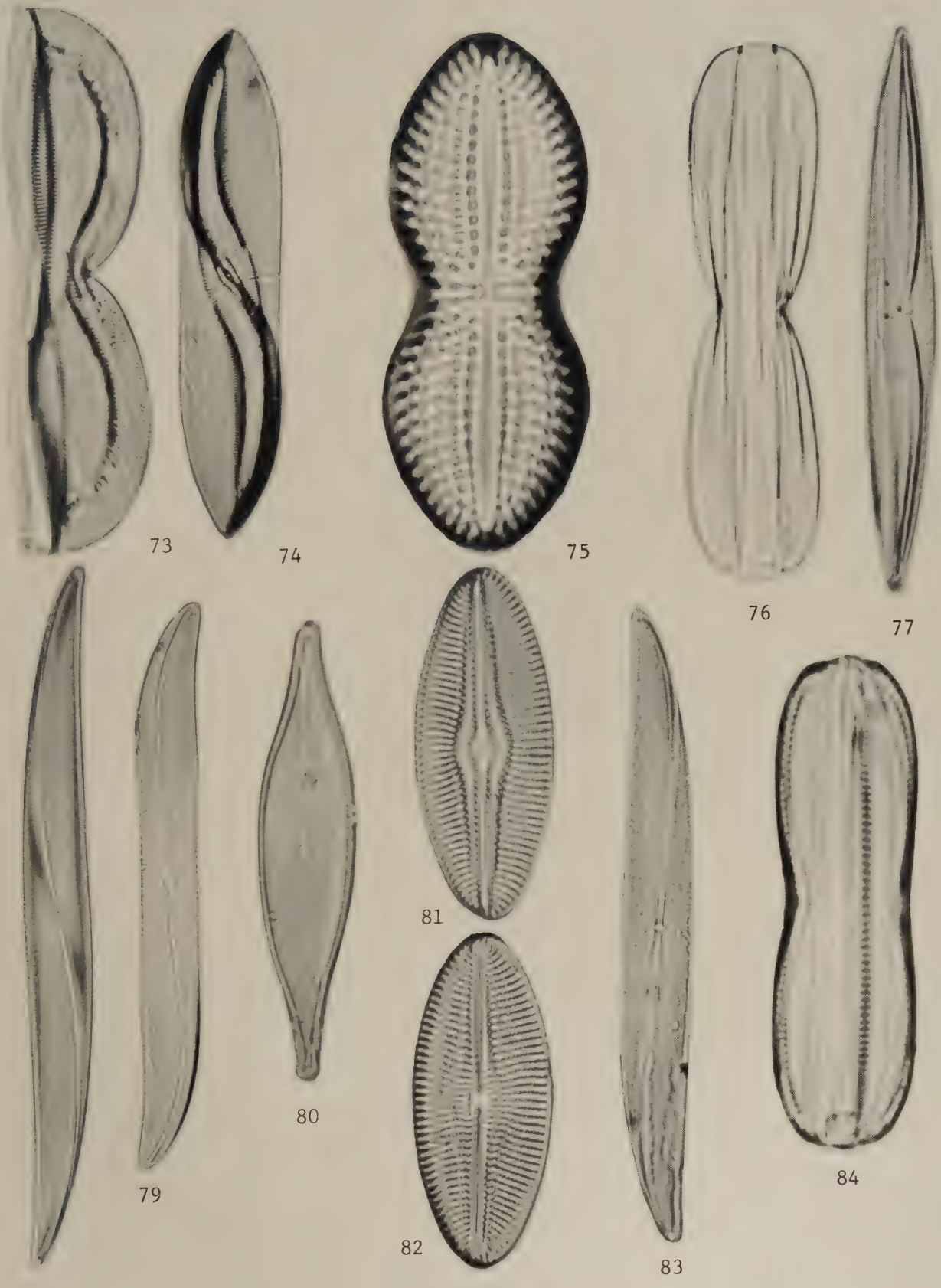


PLATE 12

PLATE 13

Figure 85. *Trachyneis aspera* – bright field. Length 92 μ. Valve view.

Figure 86. *Trachyneis aspera* – bright field. Length 87 μ. Girdle view.

Figure 87. *Navicula cancellata* – bright field. Length 48 μ. Girdle view.

Figure 88. *Navicula cancellata* – bright field. Length 86 μ. Girdle view.

Figure 89. *Navicula cancellata* – bright field. Length 74 μ. Valve view.

Figure 90. *Navicula carinifera* – bright field. Length 80 μ.

Figure 91. *Navicula clavata* – bright field. Length 127 μ.

Figure 92. *Navicula lyra* – bright field. Length 74 μ.

Figure 93. *Navicula clavata* – bright field. Length 37 μ.

Figure 94. *Nitzschia* sp. (*N. angularis ?* Smith) – bright field. Length 106 μ.

Figure 95. *Navicula forcipata* – bright field. Length 60 μ.

Figure 96. *Navicula* sp. (*Navicula longa ?* Gregory) – bright field. Length 80 μ.

Figure 97. *Diploneis crabro* – bright field. Length 44 μ.

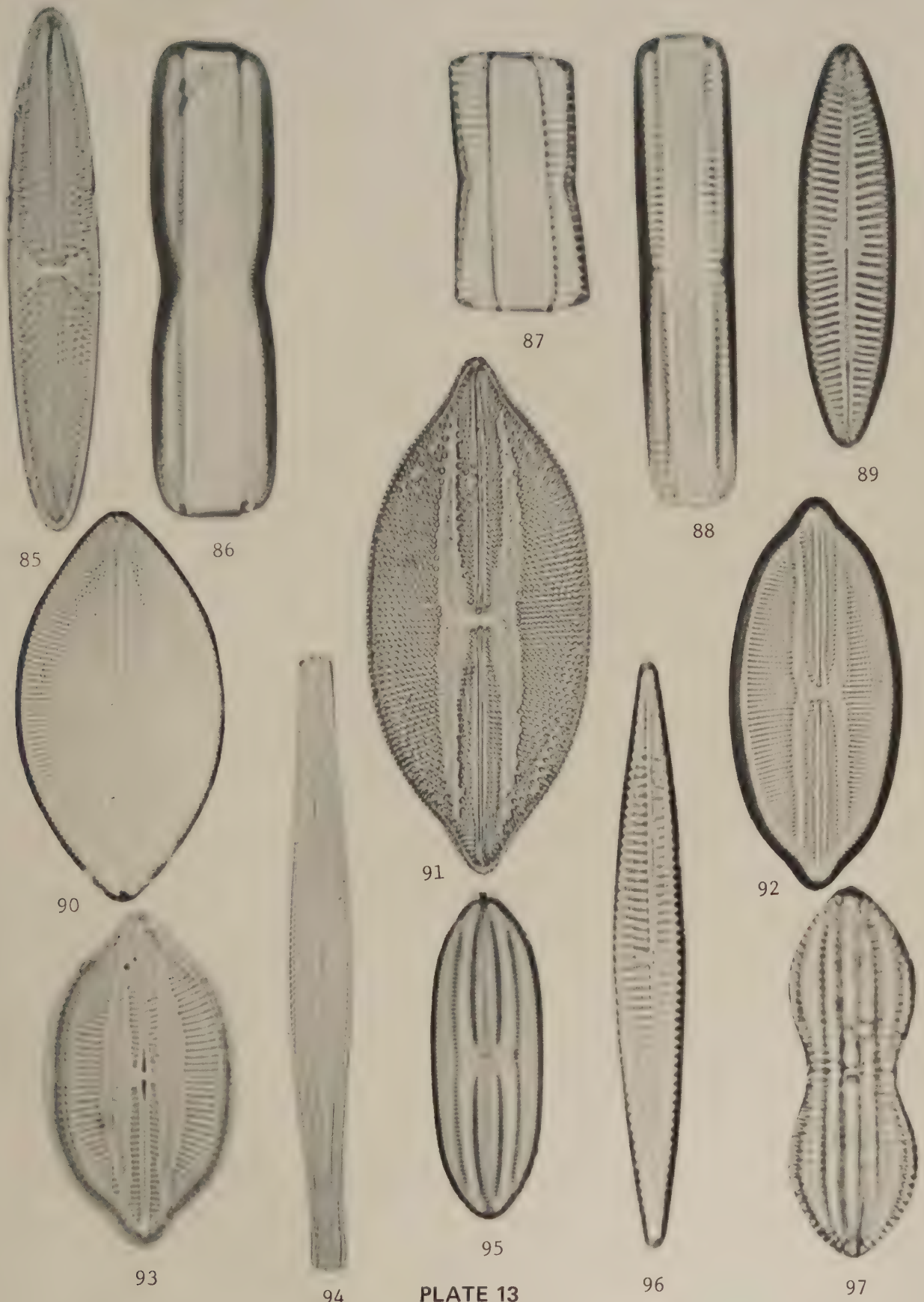


PLATE 13

PLATE 14

Figure 98. *Coscinodiscus radiatus* – bright field. Diameter 27 μ.

Figure 99. *Campylodiscus* sp. – bright field. Diameter 32 μ.

Figure 100. *Coscinodiscus eccentricus* v. *fasciculata* – bright field. Diameter 82 μ.

Figure 101. *Nitzschia panduriformis* – bright field. Length 64 μ.

Figure 102. *Nitzschia constricta* – bright field. Length 38 μ.

Figure 103. Same specimen – different plane of focus.

Figure 104. *Nitzschia* sp. – phase. No measurements taken.

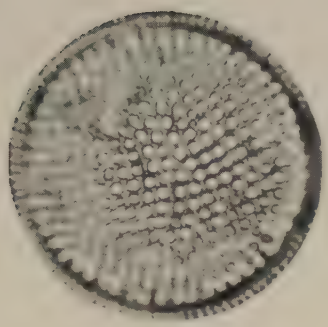
Figure 105. *Mastogloia* sp. ? – bright field. Length 54 μ.

Figure 106. *Podosira stelliger* – bright field. Diameter 50 μ.

Figure 107. *Eunotogramma marinum* – bright field. Diameter 16 μ.

Figure 108. *Navicula quarnerensoides* – bright field. Length 174 μ.

Figure 109. *Amphora spectabilis* – bright field. Length 59 μ.



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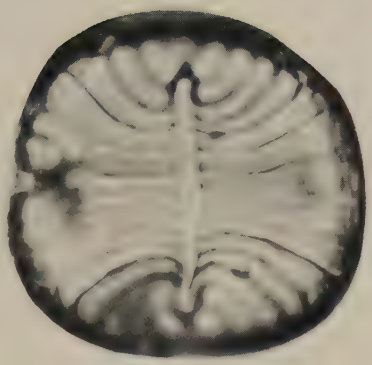

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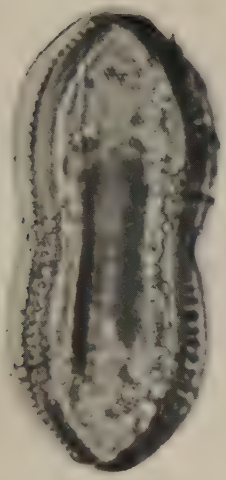

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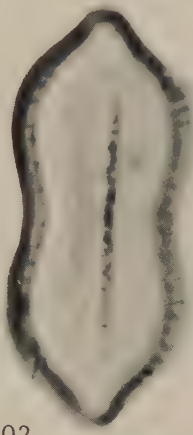

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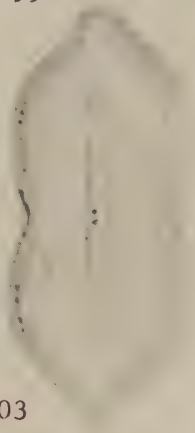

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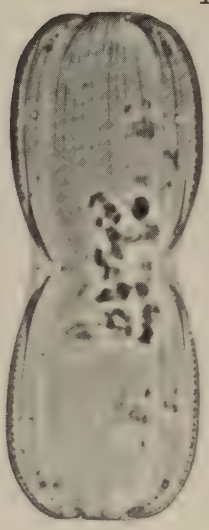

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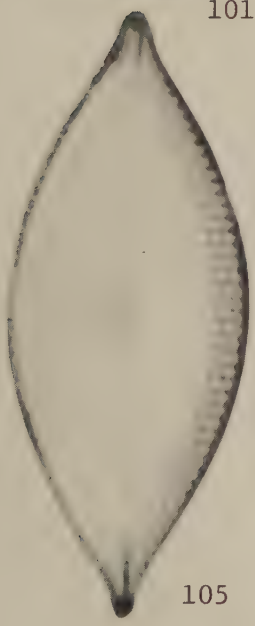

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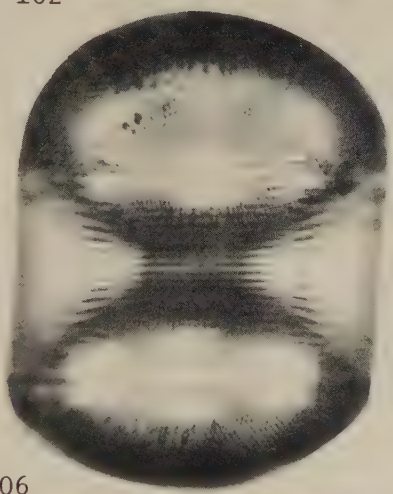

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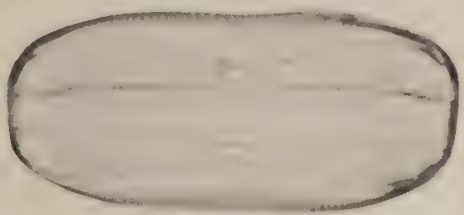

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PLATE 14

PLATE 15

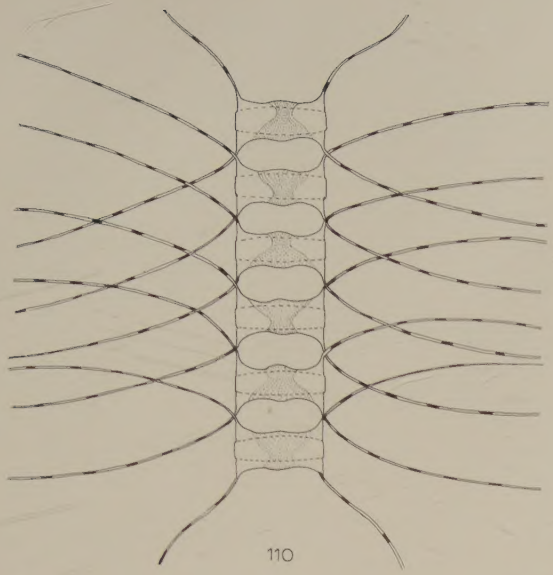
Figure 110. *Chaetoceros breve* – diameter 17 μ.

Figure 111. *Chaetoceros orientalis ?* – diameter 5 μ.

Figure 112. *Chaetoceros atlanticum* v. *neapolitana* – diameter 7 μ.

Figure 113. *Chaetoceros densum* – diameter 28 μ.

Figure 114. *Chaetoceros anastomosans* – diameter 12 μ.



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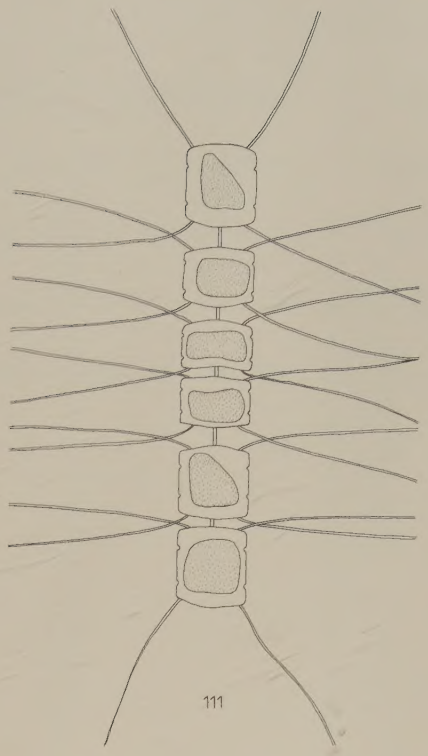

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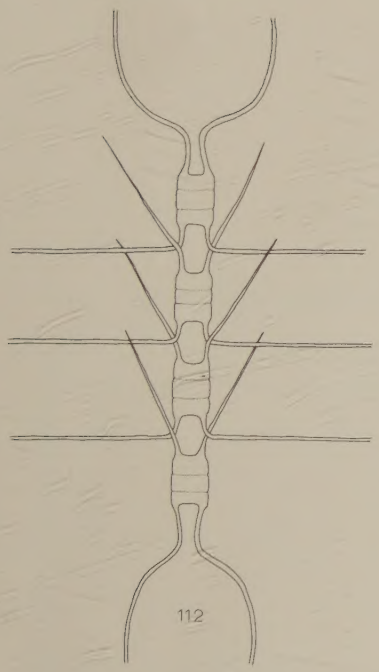

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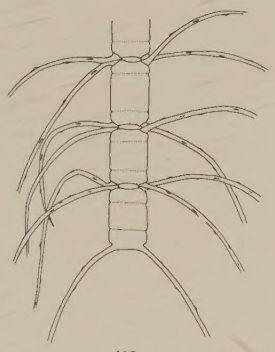

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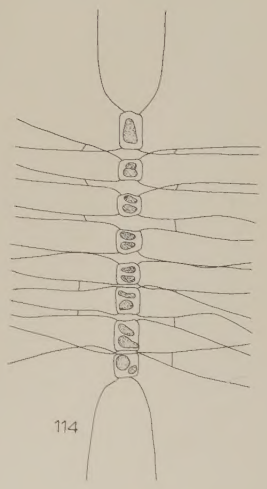

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PLATE 15

PLATE 16

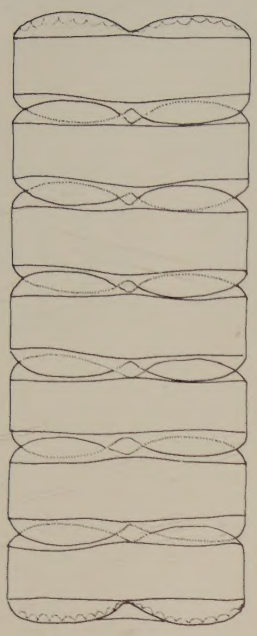
Figure 115. *Amphiprora* sp. – diameter 72 μ.

Figure 116. *Porosira* sp. – diameter 102 μ.

Figure 117. *Cyclotella* sp. – diameter 15 μ.

Figure 118. *Navicula wawrikae* – length 470 μ, diameter (at cell center) 5 μ.

Figure 119. *Navicula wawrikae* – cell near center showing detail of raphe.



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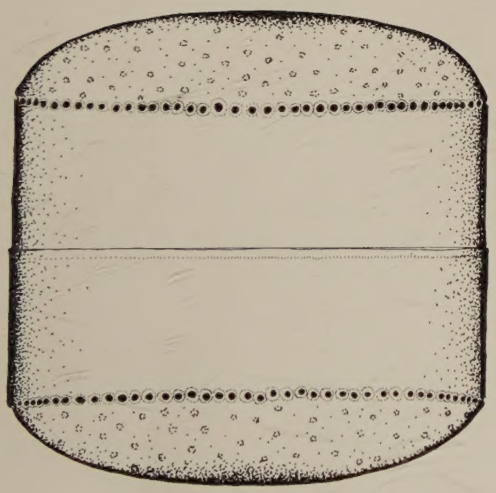

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PLATE 16